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TECHNICAL MEMORANDUM

DATE: April 26, 2012 Project No.: 436-06-11-13

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SUBJECT: Surface Water Supply Feasibility Study for Cal Water's Chico District – Summary of Surface Water Delivery Estimate and Evaluation of Preliminary Surface Water Conveyance Projects

OVERVIEW

The purpose of this technical memorandum (TM) is to assess the feasibility of utilizing Butte County's State Water Project (SWP) long-term contract supply as drinking water supply for California Water Service Company's (Cal Water's) Chico District service area. Evaluations discussed in this TM include: (1) development of the projected surface water delivery estimate; (2) initial screening of sixteen potential water supply conveyance projects and subsequent concept-level development of five of those surface water supply conveyance projects; and (3) recommendation of two preferred alternatives for further study.

Cal Water's Chico District currently relies solely on groundwater for its water supply. Based on evaluations completed in the Chico-Hamilton City District Water Supply and Facilities Master Plan (May 2008), it appears that the Chico District can continue to rely on groundwater to meet its future water demands. However, while the groundwater subbasins underlying the Chico District currently do not appear to be in overdraft, as the population increases, there becomes more competition for this resource and thereby more stress on the groundwater subbasins. Also, if there are potential water quality issues with groundwater in the future, Cal Water's complete dependence on groundwater does not provide the Chico District with supply reliability. Therefore, Cal Water is seeking to evaluate other supply alternatives to assist in diversifying its water supply portfolio, while still meeting future water demand requirements. Consequently, Cal Water is exploring the feasibility of a potential conjunctive use project with Butte County to integrate surface water supply into the Chico District service area. This proposed conjunctive use project will provide environmental, operational, and water quality benefits to multiple parties (*i.e.*, Cal Water, Butte County, and other groundwater users).

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Butte County (County) has a long-term surface water supply contract with the California Department of Water Resources (DWR) for receipt of up to a maximum amount of 27,500 acre-feet/year (AFY) from DWR's SWP, as designated in Table A of the surface water supply contract (Table A supply). The County is currently seeking in-county purchasers for this contract supply, and this study assumes that up to 20,000 AFY would be available for delivery to the Chico District. Historically, the County has worked with DWR to evaluate options for conveying SWP water from Lake Oroville to the Chico area for both municipal use and groundwater recharge. However, at this time, there is currently no infrastructure in place to move water from Lake Oroville to a location where it could be utilized by the Chico District.

This study conducts a conceptual-level investigation to determine the infrastructure needs, potential environmental impacts, administrative and legal issues, planning-level costs, and schedule to bring surface water supply into the Chico District service area. This study represents a first step toward utilizing the County's SWP supply as an alternative source of water supply for the Chico District and would position Cal Water to conduct more detailed implementation studies, environmental review and pre-design.

West Yost Associates (West Yost) received authorization to perform this work from Cal Water on January 25, 2011.

In summary, based on the results from the evaluation of several different monthly surface water delivery projections, the baseload delivery option was selected for implementation in the Chico District because it would result in the smallest required water treatment plant capacity. Under a baseload delivery option, 20,000 AFY of Table A surface water supply will be evenly split and delivered for treatment over 12 months. A baseload delivery option would require a new water treatment plant with a minimum treatment capacity of 18 mgd.

In addition, based on the results from the concept-level evaluation of the five selected preferred surface water supply conveyance projects, the two preferred alternatives selected for further study include the following:

- Pipeline along the Abandoned Sacramento Northern Railroad from Thermalito Forebay; and
- Diversion from the Sacramento River using Radial Collector Wells (will require a surface water exchange between U.S. Bureau of Reclamation and DWR).

These preferred alternatives combine the benefits of ease of implementation/operation as well as lower capital costs. Additional analyses will be required to further define these two preferred alternatives before selecting the final preferred alternative for potential design and construction. West Yost will work with Cal Water to define work tasks to be completed in 2012.

PROJECTED SURFACE WATER DELIVERY ESTIMATE FOR THE CHICO DISTRICT

This study assumes that up to 20,000 AFY from the County's SWP long-term water supply contract would be available for delivery to the Chico District. Based on this delivery volume, the following sections present the potential projected monthly surface water delivery estimates and peak surface water supply targets using the Chico District's projected future (2030) water demands. The projected monthly surface water delivery estimates assume that Cal Water will

directly treat and use the delivered surface water as an alternate source of water supply for the Chico District. However, if untreated surface water will be used for groundwater recharge, surface water delivery requirements will likely be different. Further evaluation of groundwater conditions, recharge methods, and recharge infrastructure will need to be conducted to assess delivery requirements to support recharge of groundwater. It is likely that delivery requirements for groundwater recharge will be more uniform on an annual cycle than some delivery requirements presented in the following sections because the delivery requirements for groundwater recharge do not need to meet peak water demand targets.

Historical Monthly Water Production

Historical monthly water production data from the Chico District was evaluated to determine the average monthly water use trend when compared to the total annual water production. This historical trend was used to project the monthly water production requirements in 2030. Table 1 summarizes the historical average monthly water production for the Chico District.

As shown in Table 1, historical data indicates that the Chico District's highest monthly water production has historically occurred in July, which corresponds with the high temperatures and minimal rainfall that is experienced in the service area during the summer months.

Table 1. Historical Average Monthly Water Production[a,b]

Month	Percent of Total Annual Water Production
January	4.2%
February	4.0%
March	5.1%
April	6.9%
May	10.1%
June	12.3%
July	14.7%
August	13.9%
September	11.1%
October	8.2%
November	5.1%
December	4.4%

(a) Source: *ch wtrpr 3 2006.xls* file provided by Cal Water staff for the 2008 Chico-Hamilton City District Water Supply and Facilities Master Plan (WSFMP).
(b) Based on monthly water production data from 1980 through 2006.

Projected 2030 Monthly Surface Water Delivery

The historical average monthly water production trend summarized in Table 1 was used to project the monthly water production requirements in 2030. Based on the projected annual water production in 2030 for the Chico District (53,600 AFY[1]), Figure 1 illustrates the projected monthly water production in 2030; the existing 2006 monthly water production totals are provided for comparison.

Assuming that up to 20,000 AFY from the County's SWP long-term water supply contract would be available for delivery and direct use in the Chico District; the projected monthly water production in 2030 will then be supplied from a combination of groundwater and treated surface water supplies. The projected monthly quantity of treated surface water supply delivered will depend on Cal Water's preferred timing for raw surface water delivery and other factors such as water treatment plant (WTP) capacity and groundwater recharge constraints. The following sections present three different projections for monthly treated surface water delivery. These projections were briefly evaluated and are discussed below. One option is recommended for potential implementation by Cal Water in the Chico District.

Baseload Delivery of Treated Surface Water Supply

Under a baseload delivery option, 20,000 AFY of Table A surface water supply will be evenly split and delivered for treatment over 12 months as shown on Figure 2. A baseload delivery option would require a new WTP with a minimum treatment capacity of 18 mgd.

One benefit of a baseload operation with uniform treated surface water deliveries in each month is that it results in the smallest required WTP capacity. Operations of the proposed WTP would be constant throughout the year. However, a baseload operation may potentially require significant distribution system improvements to deliver treated surface water during the lower water production months. For example, in the lowest water production month (*i.e.*, February), treated surface water supply is approximately 80 percent of the projected February 2030 demand. Water quality could also vary seasonally for some customers since the percentage of treated surface water and groundwater at some locations in the system would change considerably throughout the year.

Uniform Percentage Delivery of Treated Surface Water Supply

Under a uniform percentage delivery option, 20,000 AFY of Table A surface water supply would be delivered for treatment using the same trend as the historical average monthly water production to account for peaking during the summer months as shown on Figure 3. A uniform percentage delivery option would require a new WTP with a minimum treatment capacity of 31 mgd.

One benefit of a uniform percentage delivery option is that a more consistent water quality is delivered throughout the year because the treated surface water delivery area would be more uniform throughout the year (equal to approximately 40 percent of the total monthly water production during all months). As a result, distribution system improvements that would be needed to deliver water to customers would be minimized.

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[1] Source: 2008 Chico-Hamilton City District Water Supply and Facilities Master Plan.

The major drawback of the uniform percentage delivery option is that it would require a larger raw water conveyance pipeline and a WTP that is approximately 70 percent larger in capacity than the baseload delivery option. Operations of the proposed WTP would also have to vary considerably as the treated surface water delivery fluctuates from approximately 9 to 31 mgd.

October to April Delivery of Treated Surface Water Supply

Under an October to April delivery option, 20,000 AFY of Table A surface water supply would be delivered for treatment during the months from October to April as shown on Figure 4. An October to April delivery option would require a new WTP with a minimum treatment capacity of 43 mgd.

One benefit of an October to April delivery option is that raw surface water supply during the fall, winter and spring months are generally more easily available. However, an October to April delivery option will require a much larger raw water conveyance pipeline and a WTP that is approximately 140 percent larger in capacity than the baseload delivery option. In addition, the concentrated use of groundwater as a primary source of water supply during the summer months could have a more significant impact on the groundwater subbasins underlying the Chico District and may potentially create impacts to other local groundwater users. In addition, water quality would vary significantly since the concentration of treated surface water and groundwater shifts completely throughout the year. With all the potential drawbacks of this delivery option, an October to April delivery option is not recommended unless there are restrictions on surface water diversions during the summer months.

Recommended Monthly Delivery Schedule for Treated Surface Water Supply

Actual annual water deliveries from the SWP are typically less than the County's entitlement depending on a number of factors including hydrologic conditions, operational constraints, and customer demand. Depending on the reliability of the SWP, 100 percent delivery of the annual Table A supply to the Chico District would only occur in some years. As a result, sizing a WTP to include seasonal peaking would result in a WTP that is oversized under most conditions. Therefore, the baseload delivery option is recommended because the increased capital cost of a larger WTP would most likely outweigh the water distribution system savings, especially if the larger WTP will not be utilized at full capacity during most years.

Consequently, the baseload delivery option will subsequently be used to establish conceptual facility sizing for surface water and corresponding groundwater needs. It should be noted that if the raw surface water supply is diverted directly from Lake Oroville, there are no foreseeable constraints to the timing of raw surface water delivery. However, if creek conveyance or a water exchange in the Sacramento River is evaluated, potential surface water diversion constraints will need to be identified.

Future Reliability of Butte County's State Water Project Allocation

As discussed previously, the County has a long-term water supply contract for receipt of up to a maximum amount of 27,500 AFY from the SWP. However, actual annual water deliveries from the SWP are typically less than the Table A amounts depending on a number of factors including hydrologic conditions, operational constraints, and customer demand. The current (April 2011) allocation from the SWP is 80 percent of the contractors' requested amounts, which is equal to an approved allocation of 22,000 AFY for the County.

DWR develops a bi-annual State Water Project Delivery Report to document the current and future SWP water supply conditions. In the most recent 2009 State Water Project Delivery Report, findings indicate that there is a continuing erosion of the ability of the SWP to deliver water due to factors such as the restrictive operational requirements contained in the federal biological opinions and the forecasted effects of climate change. The long-term average annual SWP delivery forecasted for the County in 2029 is estimated to be approximately 59 percent of the maximum annual SWP allocation. While in some years, up to 20,000 AFY may be available to the Chico District, on a long-term average basis, approximately 11,700 AFY would be available for delivery. The Table A amount of 20,000 AFY will be used for facilities sizing, but the lower long-term average delivery amount will be used in the analysis to evaluate the annual costs of supply alternatives.

To improve the reliability of the County's SWP allocation, the County, the Solano County Water Agency and Napa County Flood Control and Water Conservation District are currently litigating to secure area of origin rights to their respective SWP allocation. This lawsuit was filed in 2007 at the Sacramento Superior Court (Case Number: 34-2008-00016338 CU-BC-GDS). If successful, the County would be able to receive its maximum annual SWP allocation during any hydrologic year, which implies that the County's SWP allocation will have 100 percent reliability at all times. As of the end of 2011, DWR and the County are currently in settlement negotiations.

SUMMARY OF POTENTIAL SURFACE WATER SUPPLY CONVEYANCE PROJECTS

The SWP's principal storage reservoir is the 3.5 million acre-foot (MAF) Lake Oroville, located on the Feather River, just east of the City of Oroville, in Butte County. In addition to storage, the reservoir is also used for power generation. Two downstream reservoirs, Thermalito Forebay and Thermalito Afterbay provide smaller storage regulating basins that are used to provide balancing storage for hydroelectric power generating stations located at the dam and between the two reservoirs. Figure 5 illustrates the locations of these reservoirs. The figure also includes Butte County's boundary and the Chico District service area boundary for reference.

To deliver Table A raw water supply to the Chico District, projects could either be diverted directly from Lake Oroville facilities, or be supplied from the Sacramento River, requiring a water exchange agreement between DWR and the U.S. Bureau of Reclamation (Reclamation). In addition, Table A supply can either be conveyed to the Chico District through a new surface WTP (*i.e.*, direct use/in-lieu groundwater recharge) or for direct groundwater recharge. Based on these criteria, including subsequent review of previous studies and discussions with Cal Water and County staff, 16 potential surface water supply conveyance projects were identified. Each conveyance project was briefly evaluated (through any previous studies available and conversations with all relevant parties), and five of the most favorable options (those highlighted in bold text) were subsequently selected for further evaluation to develop conceptual alignments and costs. As discussed in the following section, potential environmental flaws and implementation issues were then reviewed for each of these five potential surface water supply conveyance projects to help screen and select the two best projects recommended for further study.

The projects included in the initial screening are:

1. **Pipeline along the Oro-Chico Conduit from Thermalito Forebay**
2. Pipeline along the Oro-Chico Conduit from Thermalito Afterbay
3. Pipeline/Canal along the Oro-Chico Conduit from Thermalito Forebay
4. Pipeline/Canal along the Oro-Chico Conduit from Thermalito Afterbay
5. **Pipeline along the Abandoned Sacramento Northern Railroad from Thermalito Forebay**
6. Pipeline along the Abandoned Sacramento Northern Railroad from Thermalito Afterbay
7. Pipeline/Canal along the Abandoned Sacramento Northern Railroad from Thermalito Forebay
8. Pipeline/Canal along the Abandoned Sacramento Northern Railroad from Thermalito Afterbay
9. **Diversion from the Sacramento River using M&T Chico Ranch Diversion Facility**
10. Diversion from the Sacramento River (DWR, Reclamation Exchange) using a New Conventional Diversion Structure
11. **Diversion from the Sacramento River (DWR, Reclamation Exchange) using Radial Collector Wells**
12. Pipeline to Butte Creek, and Conveyance using Butte Creek, with Groundwater Recharge
13. Pipeline to Big Chico Creek, and Conveyance using Big Chico Creek, with Groundwater Recharge
14. **Participation in the Regional Paradise Irrigation District (PID) Project**
15. Partnership with Rancho Esquon
16. Partnership with PG&E to use PG&E's Hendricks Canal

Figure 6 shows the approximate location of each potential surface water supply conveyance project listed above.

For the remaining projects that were not initially selected as part of the five potential surface water supply conveyance projects selected for further evaluation, Table 2 provides a brief summary of the reasons why they were eliminated from further evaluation.

Table 2. Summary of Eliminated Surface Water Supply Conveyance Projects

Project Number (Project Type)	Reason(s) for Elimination
2, 4, 6 and 8 (Diversion from Thermalito Afterbay)	A review of water surface elevations at Thermalito Forebay (max. water surface elevation = 225 ft) and Thermalito Afterbay (max. water surface elevation = 136 ft) indicates that a surface water diversion facility from Thermalito Afterbay would require a higher lift, and thus a larger pump station with higher electrical costs to deliver water to the Chico District. Since there are currently no restrictions on diversions from Thermalito Forebay, it would be a more suitable diversion than Thermalito Afterbay due to its higher elevation. The Forebay also has potential for gravity flow with a conveyance canal.
3 and 7 (Canal Alignment)	Some potential issues with an open channel include: conveyance losses, additional maintenance, contamination, *etc*. A closed pipeline would eliminate these issues and is recommended based on its much higher reliability than an open channel supply.
10 (New Conventional Diversion Structure from the Sacramento River)	This project was eliminated because Projects 9 and 11, which had similar project elements were selected for further evaluation. Project 9 proposes a shared conventional diversion structure with M&T Chico Ranch (M&T), which presents an opportunity for a partnership to utilize existing resources. Project 11 proposes using radial collector wells as an alternative to a conventional diversion structure because of their potential to limit impacts to fishery and provide more uniform water quality. Due to the potential advantages of Projects 9 and 11, a new conventional diversion structure was not considered for further evaluation. However, if further evaluation of radial collector wells indicates that they are not a feasible diversion facility then a new conventional diversion structure may be a potential project.
12 and 13 (Groundwater Recharge using Creek for Conveyance)	Various environmental and regulatory issues such as sensitive fishery habitat and water rights issues make these options difficult to implement, and possibly infeasible. In addition, potential issues with extracting water out of the groundwater basin after direct recharge also make this project less appealing due to the associated complications with withdrawal. It should be noted that Butte Creek is adjudicated and has one of the only remaining salmon spawning areas in the Central Valley.
15 (Partnership with Rancho Esquon)	Rancho Esquon diverts water from Butte Creek for agricultural use. During the summer months, diversions from Butte Creek are limited, and Rancho Esquon relies mostly on their groundwater wells for water supply. Rancho Esquon could potentially partner with Cal Water to use surface water during dry hydrologic years. If a partnership were arranged with Cal Water, Rancho Esquon would prefer surface water deliveries of at least 5,000 acre-feet during the summer months to replace current groundwater use at a maximum cost of $50/acre-feet. Based on these water delivery and cost requirements, it does not appear that a partnership with Rancho Esquon is feasible.
16 (Partnership with PG&E)	PG&E has water rights on the West Branch Feather River and operates various hydropower facilities on Butte Creek that use a mix of Butte Creek and Feather River supply. The Feather River supply is delivered via Hendricks Canal. A partnership with PG&E would allow Cal Water to divert upstream of Lake Oroville and use Butte Creek as conveyance. However, Hendricks Canal is utilized at maximum capacity whenever possible by PG&E and additional diversions will require expansion of Hendricks Canal. In addition, Cal Water will need to demonstrate that any water diverted is in surplus of PG&E's water rights. With these constraints, a partnership with PG&E would be complex and does not seem feasible.

EVALUATION OF FIVE PREFERRED SURFACE WATER SUPPLY CONVEYANCE PROJECTS

Based on the five surface water supply conveyance projects selected in the initial screening, additional analyses were completed to develop conceptual level information (*e.g.*, infrastructure requirements, estimated costs, issues, and constraints, *etc*.) for each of these preferred projects. This information was then used to screen and identify two preferred alternatives for further study. Details of these analyses are presented in the following sections below.

Summary of Preferred Surface Water Supply Conveyance Projects

A brief description of each preferred surface water supply conveyance project is provided below. This information was then compiled and developed into a matrix to help evaluate the advantages and disadvantages of each project. The screening evaluation developed to select two preferred project alternatives for further study is presented following these brief project descriptions.

Alternative 1 (Project 1) – Pipeline along the Oro-Chico Conduit from Thermalito Forebay

The concept for the Oro-Chico Conduit alignment was first developed by DWR Northern District to determine if a multi-purpose project justified primarily by groundwater recharge benefits would be feasible. Project alternatives developed for this conceptual plan were presented in a cursory report titled, “The Oro-Chico Conduit Conceptual Plan”. Conclusions from this report did not identify any fatal flaws, but questioned whether continued study of the Oro-Chico Conduit is warranted because of the high capital costs, and the preliminary results from the Butte Basin groundwater modeling that shows the area does not clearly indicate a need for additional groundwater recharge at that point in time. Since the completion of this cursory report in April 1997, no additional work has been completed on the Oro-Chico Conduit conceptual plan.

As an alternative to a project justified primarily by groundwater recharge benefits, the concept of the Oro-Chico Conduit alignment could be modified into a potential project to deliver Table A supply to the vicinity of the Chico District for direct use after treatment. Modifications include using a closed pipeline instead of the open canal originally identified in the Oro-Chico Conduit Conceptual Plan to eliminate the issues associated with an open channel. A new water treatment plant would also be required to treat the raw surface water diverted from Thermalito Forebay. For this study, the water treatment plant is assumed to be located near the Chico District service area boundary. Based on the topography from Thermalito Forebay to the Chico District, a raw water booster pump station will be required to deliver surface water to the proposed WTP located in the vicinity of the Chico District.

This project would require a new turnout and diversion facility from the Thermalito Forebay and approximately 19 miles of raw water transmission pipeline roughly following the Oro-Chico Conduit alignment (basically the 220’ contour) to deliver the proposed 20,000 AFY of Table A supply to the Chico District for treatment. Based on a baseload delivery option for the proposed WTP, Table 3 provides preliminary details on the recommended infrastructure to deliver treated Table A supply to the Chico District under Alternative 1.

Table 3. Alternative 1 – Preliminary Details on Recommended Infrastructure[a,b]

Infrastructure Type	Length/Capacity Recommended	Unit
Raw Water Intake Structure	28	cfs
Raw Water Booster Pump Station	18 (firm)	mgd
42-inch diameter Raw Water Pipeline	101,000	feet
Water Treatment Plant	18	mgd

(a) Assumes raw water delivery from Thermalito Forebay to the Chico District service area boundary.
(b) Assumes baseload delivery of Table A supply.

Some potential considerations that may complicate this project would be any potential easement issues, environmental impacts on wildlife and creek crossings.

Alternative 2 (Project 5) – Pipeline along the Abandoned Sacramento Northern Railroad from Thermalito Forebay

The concept for the Sacramento Northern Railroad alignment was developed in the Butte County Integrated Water Resources Plan[2] as an option that could be implemented to help meet the County's future water management needs. In the County's Integrated Water Resources Plan, it was proposed that a canal could be built along the abandoned Sacramento Northern Railroad alignment to provide Table A supply for irrigation needs in the summer, decomposition water in the fall, and for habitat creation near the Cherokee Strip and Esquon (areas southeast of Little Dry Creek). The abandoned railroad alignment would mostly provide a clear pathway for the proposed canal without dividing existing farms.

As an alternative to a project to supply irrigation needs, decomposition water, and habitat creation near the Cherokee Strip and Esquon, the concept of the abandoned Sacramento Northern Railroad alignment could be modified into a potential project to deliver Table A supply to the vicinity of the Chico District for direct use after treatment. Modifications include using a closed pipeline instead of the open canal originally identified in the County's Integrated Water Resources Plan to eliminate the issues associated with an open channel. A new WTP would also be required to treat the raw surface water diverted from Thermalito Forebay. This study assumes that the WTP would be located near the Chico District service area boundary. Based on the topography from Thermalito Forebay to the Chico District, a raw water booster pump station will be required to deliver surface water to the proposed WTP located in the vicinity of the Chico District.

This project would require a new turnout and diversion facility from the Thermalito Forebay and approximately 18 miles of raw water transmission pipeline roughly following the abandoned Sacramento Northern Railroad alignment to deliver the proposed 20,000 AFY of Table A supply to the Chico District for treatment. Based on a baseload delivery option for the proposed WTP, Table 4 provides preliminary details on the recommended infrastructure to deliver treated Table A supply to the Chico District under Alternative 2.

[2] Integrated Water Resources Plan, prepared for Butte County department of Water and Resource Conservation by CDM, May 2005.

Table 4. Alternative 2 – Preliminary Details on Recommended Infrastructure[(a,b)]		
Infrastructure Type	Length/Capacity Recommended	Unit
Raw Water Intake Structure	28	cfs
Raw Water Booster Pump Station	18 (firm)	mgd
42-inch diameter Raw Water Pipeline	95,000	feet
Water Treatment Plant	18	mgd

(a) Assumes raw water delivery from Thermalito Forebay to the Chico District service area boundary.
(b) Assumes baseload delivery of Table A supply.

Some potential considerations that may complicate this project would be any potential easement issues, environmental impacts on wildlife and creek crossings.

Alternative 3 (Project 9) – Diversion from the Sacramento River using M&T Chico Ranch Diversion Facility

The concept for a surface water exchange between Reclamation and DWR was presented previously in an internal DWR memo, which documented the cost evaluation of four potential surface water conveyance systems for the County that would more fully utilize their Table A supply. This memo, dated January 15, 2007, identified one potential surface water conveyance system, which would require implementing a surface water exchange from the available supply on the Feather River to a diversion from the Sacramento River using an existing diversion structure at the M&T Chico Ranch property. This type of water exchange will significantly reduce the length of transmission facilities required to deliver water to the Chico District due to the closer proximity of the Sacramento River.

A surface water exchange between Reclamation and DWR would basically require DWR to release an amount of water into the Feather River from Lake Oroville in exchange for a like amount of water provided by Reclamation from Lake Shasta for diversion from the Sacramento River near the Chico District. Exchange arrangements between Reclamation and DWR are common for a number of reasons that recognize the operational needs of both the SWP and the federal Central Valley Project (CVP). In order to assess the institutional reception for such an exchange, County and West Yost staff held a series of meetings with the State Water Contractors (a water user organization consisting of most of the SWP water contractors), DWR, and Reclamation staff to discuss the feasibility of the potential water exchange. Through these initial meetings, it can be concluded that all parties were generally supportive of an exchange to help the County more fully utilize their allocated SWP contract (Table A) supply.

One potentially significant issue identified by Reclamation staff is that mitigation would be required to offset potential impacts to cold-water pool operations at Lake Shasta. To protect federally listed endangered salmon in the Sacramento River, Reclamation is required to release cooler water from Lake Shasta to maintain downstream temperatures in the Sacramento River cool enough for salmon spawning and survival. Operations are impacted by the size and temperature of the pool of water in the lake. Temperature management is more difficult during drought periods, when the lake is drawn down -- the cold-water pool volume is smaller and Reclamation is also making operational decisions to manage and conserve supply.

A possible mitigation would be to reduce or cease deliveries during drought periods. In discussions with Reclamation staff, any dry period where there are two or more dry years back-to-back are potentially problematic. Annual estimates of future SWP deliveries and Sacramento River hydrologic data were used to roughly estimate the worst-case scenario for the percentage of years that would be affected and the impact on long-term delivery amounts of Table A supply. Estimates were derived using a historical (1922 through 2003) hydrologic data set that is used by DWR for planning studies. This analysis indicates that approximately 20 percent of years would be subject to potential curtailment, with a corresponding reduction in long-term annual deliveries of 11 percent. The percentage reduction in water deliveries is lower than the percentage of years affected because deliveries are lower in drought years.

As discussed above, the long-term average annual delivery quantity for 20,000 AFY of Table A supply is estimated to be 11,700 AFY. For the Sacramento River exchange concept, the long-term delivery quantity would drop to 10,500 AFY. However, additional discussions with Reclamation staff and/or long-term/temperature modeling will be required to estimate the actual quantity of water that could be delivered.

With the preliminary support from the State Water Contractors, DWR, and Reclamation staff, it was assumed that a surface water exchange can be negotiated and implemented. Implementation of such an exchange between Reclamation and DWR would likely be through a long-term operational exchange agreement. Notes from each of these meetings are included in Attachment A for reference. In summary, major contract items to address before implementation of a water exchange would include point of transfer, names and locations of water exchange parties and place of use for exchange water. Potential delivery constraints during dry years would need to be addressed by long-term modeling of CVP supplies.

Assuming that a water supply exchange agreement can be negotiated between Reclamation and DWR to allow for the Chico District to divert water from the Sacramento River, Alternative 3 proposes sharing an existing conventional diversion structure on the Sacramento River with M&T Chico Ranch, as shown on Figure 6. M&T currently operates a pumped surface water diversion on the Sacramento River near River Road. The existing diversion facility has capacity for an additional pump (~40 cfs), which M&T does not plan to utilize in the future. Therefore, Cal Water can potentially partner with M&T to install an additional pump and utilize the existing diversion structure to deliver surface water to the Chico District for direct use after treatment.

In addition to the new raw water booster pump, this project would also require approximately 5 miles of raw water transmission pipeline roughly following the alignment of Chico River Road to deliver the proposed 20,000 AFY of exchanged water to the Chico District for treatment. Based on a baseload delivery option for the proposed WTP, Table 5 provides preliminary details on the recommended infrastructure to deliver treated surface water supply to the Chico District under Alternative 3.

One significant operational issue that Cal Water would have to contend with under Alternative 3 is the encroaching gravel bar located in the Sacramento River near the M&T pumped diversion intake structure. The gravel bar is migrating downstream and requires significant maintenance, which Cal Water would have to share if Alternative 3 is selected for implementation.

Table 5. Alternative 3 – Preliminary Details on Recommended Infrastructure[a,b]

Infrastructure Type	Length/Capacity Recommended	Unit
Raw Water Booster Pump	18	mgd
42-inch diameter Raw Water Pipeline	26,000	feet
Water Treatment Plant	18	mgd

(a) Assumes surface water diversion is located at M&T's existing diversion structure.
(b) Assumes baseload delivery of surface water supply.

It should be noted that the feasibility of Alternative 3 is completely dependent on the major assumption that a surface water exchange in the Sacramento River can be negotiated and implemented. Initial meetings with the State Water Contractors, DWR, and Reclamation staff indicate that all parties were generally supportive of such an exchange. Until further evaluations are completed, there are currently no fatal flaws that suggest a water supply exchange agreement could not be negotiated between Reclamation and DWR. Potential considerations that could complicate this project include potential easement and/or intake diversion issues, multiple party negotiations required for project implementation, and environmental impacts on wildlife. The delivery reliability of this project would be less than projects that deliver water from Lake Oroville, due to the potential need to curtail deliveries during some dry years to avoid impacting CVP Sacramento River operations.

Alternative 4 (Project 11) – Diversion from the Sacramento River using Radial Collector Wells

Alternative 4 also assumes that a water exchange in the Sacramento River will be negotiated and implemented, as discussed previously in Alternative 3. However, under Alternative 4, a new alternative intake structure (*i.e.*, radial collector well, also commonly referred to as a Ranney Collector) is proposed for diverting surface water from the Sacramento River. Radial collector wells are generally located near a river and are comprised of a vertical large-diameter reinforced concrete shaft (or caisson) with horizontal lateral well screens projected out into the aquifer to collect subsurface water (see Figure 7). The proposed location for the radial collector wells is shown on Figure 6 (near Hamilton City).

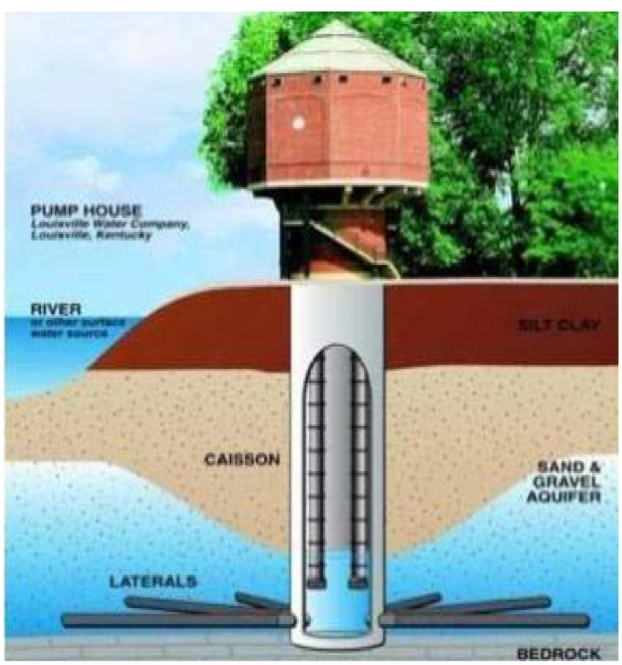

Figure 7. Schematic of a Typical Radial Collector Well

Because this type of project is not the typical surface water intake diversion structure, additional work was performed to evaluate the feasibility of using a radial collector well as a potential intake structure before selecting this project as one of the five preferred projects recommended for further evaluation. Results

from the evaluation are presented in a separate memorandum prepared by West Yost (see Attachment B). In this memorandum, West Yost recommended that the Chico District further evaluate the feasibility of radial collector wells for the proposed Sacramento River diversion. Potential benefits of radial collector wells include:

- No in-water construction
- No impacts to fishery
- More uniform water quality
- Avoidance of operational difficulties associated with a conventional screened surface water intake

Based on the preliminary radial collector well design assumed and evaluated in Attachment B, two radial collector wells would be preliminarily recommended for Alternative 4. In addition to the proposed radial collector wells, this project would also require approximately 6 miles of raw water transmission pipeline roughly following the alignment of Highway 32 to deliver the proposed 20,000 AFY of exchanged water to the Chico District for treatment. Based on a baseload delivery option for the proposed WTP, Table 6 provides preliminary details on the recommended infrastructure to deliver treated surface water supply to the Chico District under Alternative 4.

Table 6. Alternative 4 – Preliminary Details on Recommended Infrastructure[a,b]

Infrastructure Type	Length/Capacity Recommended	Unit
Two (2) Radial Collector Wells	28	cfs
42-inch diameter Raw Water Pipeline	31,000	feet
Water Treatment Plant	18	mgd

(a) Assumes surface water diversion is located near Hamilton City.
(b) Assumes baseload delivery of surface water supply.

It should be noted that the feasibility of Alternative 4 is completely dependent on the major assumption that a surface water exchange in the Sacramento River can be negotiated and implemented. As discussed previously, there are currently no fatal flaws that suggest a water supply exchange agreement could not be negotiated between Reclamation and DWR. Some other potential considerations that may complicate this project would be any potential easement and/or intake diversion issues and environmental impacts on wildlife. The delivery reliability of this project would be less than projects that deliver water from Lake Oroville, due to the potential need to curtail deliveries during some dry years to avoid impacting CVP Sacramento River operations.

Alternative 5 (Project 14) – Participation in the Regional Paradise Irrigation District Project

The concept of potentially expanding the Regional PID Project through a joint partnership with PID was identified during a conference call on May 11, 2011 with George Barber, District Manager at PID. As discussed during the conference call, PID is currently looking to improve its water supply reliability during drought years with the design and construction of a new transmission main to divert additional water from the Upper Miocene Canal to their WTP located at Magalia Reservoir. Because of the significant uphill gradient from the Upper Miocene Canal to PID's WTP, a large booster pump facility will also be required to deliver water to the WTP. The proposed transmission main can be designed to also meet the Chico District's water supply needs and its full capacity will be available to the Chico District during normal and wet hydrologic years.

A potential joint project to deliver treated surface water to the Chico District would require (1) expanding the planned booster pump station or constructing a new booster pump station and transmission main to divert additional water from PG&E's Upper Miocene Canal to PID's WTP, (2) increasing the treatment capacity at PID's existing WTP, which currently has a treatment capacity of 19 mgd, and (3) constructing additional transmission facilities to deliver treated surface water directly to the Chico District. With this joint project, Cal Water would not have to design, construct or operate a water treatment plant.

Cal Water staff met with George Barber on July 13, 2011 to further discuss preliminary details of a possible joint partnership to expand the Regional PID Project. It was clarified during this meeting that PID's existing WTP can be expanded to 25 mgd or greater to meet Cal Water's needs. Therefore, it is assumed that 20,000 AFY of treated Table A supply could be delivered to the Chico District. In addition, due to the downhill gradient from PID to the Chico District, there is a potential for in-line hydropower generation.

A significant issue that could affect the sizing of the WTP expansion is the potential for impacts to existing senior water rights within the watershed (PG&E is the major water rights holder in the upper watershed). Historically, DWR's point of diversion is assumed to be at Lake Oroville, based on water received into the reservoir. If diversions were to be made upstream of the lake, they would need to be made after all senior water rights are satisfied, so as to not impact senior water rights holders. This would likely mean diversions may be limited to winter and spring months when surplus water is more likely to be available. If diversions are not able to be made on a year-round basis, the WTP size would need to be increased to accommodate the shorter diversion window. This could significantly increase project capital costs. It is also unlikely that PID would have sufficient land to accommodate a larger WTP.

In summary, this project would require expansion of planned or new diversion facilities from the Upper Miocene Canal and approximately 1 mile of raw water transmission pipeline between the Upper Miocene Canal and PID's WTP to deliver the proposed 20,000 AFY of Table A supply for treatment. Because PID's existing WTP does not have sufficient capacity to treat 20,000 AFY of Table A supply to the Chico District, an expansion of the existing WTP would be required. Even though Cal Water would not have to design, construct or operate the WTP, it is assumed that a proportionate cost of the WTP expansion would be allocated to Cal Water if the Chico District were to receive treated Table A supply delivered through PID facilities. In addition, approximately 16 miles of gravity transmission pipeline

would also be required to deliver treated surface water into the Chico District water distribution system. Based on a baseload delivery option for the proposed PID water treatment plant expansion, Table 7 provides preliminary details on the recommended infrastructure to deliver treated Table A supply to the Chico District under Alternative 5. For the purposes of preliminary sizing, year-round delivery is assumed. However, facilities would likely need to be larger to not impact senior water rights holders.

Table 7. Alternative 5 – Preliminary Details on Recommended Infrastructure[a,b]

Infrastructure Type	Length/Capacity Recommended[c]	Unit
Raw Water Intake Structure	28	cfs
Raw Water Booster Pump Station	18	mgd
42-inch diameter Raw Water Pipeline	6,000	feet
PID WTP Expansion	18	mgd
42-inch diameter Treated Water Pipeline	83,000	feet
In-line Hydropower Facility	18	mgd

(a) Assumes surface water diversion is located near the confluence of the Upper Miocene Canal and West Branch Feather River.
(b) Assumes baseload delivery of Table A supply.
(c) Assumes Cal Water's share of the regional project is sufficient for PID's proposed drought year supply.

Some potential considerations that may complicate this project would be potential water rights issues (*e.g.*, timing of deliveries) with diverting water upstream of Lake Oroville, easement issues, multiple party negotiations required for project implementation, environmental impacts on wildlife, and creek crossings.

Screening Evaluation to Select Two Preferred Alternatives for Further Study

Based on the information provided for each preferred project described above, West Yost developed a matrix comparison to help evaluate the five preferred projects. Additional information such as estimated conveyance costs and schedule was also added to the matrix. It should be noted that the estimated conveyance costs developed for each project do not include the costs required to purchase Table A supply or for land acquisition. Water treatment costs are also not included, as they are assumed to be similar for each of the alternatives.

Table 8 presents the matrix comparison used to highlight key conceptual level information such as infrastructure requirements and estimated cost including political, institutional, environmental, and operational considerations used to evaluate the feasibility of each project. An evaluation of the potential advantages and disadvantages presented for each project, as shown in Table 8, indicates that the two preferred project alternatives that are the most feasible at this time would be Alternatives 2 and 4.

Table 8. Matrix Comparison of Preferred Surface Water Conveyance Projects

	Alternative 1 – Pipeline along the Oro-Chico Conduit from Thermalito Forebay	Alternative 2 – Pipeline along the Abandoned Sacramento Northern Railroad from Thermalito Forebay	Alternative 3 – Diversion from the Sacramento River using M&T Chico Ranch Diversion Facility	Alternative 4 – Diversion from the Sacramento River using Radial Collector Wells	Alternative 5 – Participation in the Regional Paradise Irrigation District (PID) Project
Type of Project	• Direct use of Table A supply	• Direct use of Table A supply	• Use of Table A supply via a water exchange	• Direct use of Table A supply via a water exchange	• Delivery of Table A supply via PG&E and Paradise Irrigation District facilities upstream of Lake Oroville
Quantity of Supply Available for Treatment[(a)]	• Maximum delivery of 20,000 AFY • Actual volume delivered depends on environmental and climatic factors determined annually by DWR • Estimated long-term average delivery of 11,700 AFY	• Maximum delivery of 20,000 AFY • Actual volume delivered depends on environmental and climatic factors determined annually by DWR • Estimated long-term average delivery of 11,700 AFY	• Maximum delivery of 20,000 AFY • Actual volume delivered depends on environmental and climatic factors determined annually by Reclamation and DWR • Estimated long-term average delivery between 10,500 and 11,700 AFY (additional discussions required with Reclamation staff to confirm actual quantity that can be delivered)	• Maximum delivery of 20,000 AFY • Actual volume delivered depends on environmental and climatic factors determined annually by Reclamation and DWR • Estimated long-term average delivery between 10,500 and 11,700 AFY (additional discussions required with Reclamation staff to confirm actual quantity that can be delivered)	• Assumed maximum delivery of 20,000 AFY • Actual volume delivered depends on environmental and climatic factors determined annually by DWR • Estimated long-term average delivery less than 11,700 AFY due to uncertainty from potential water rights issues • Diversions would need to demonstrate no adverse impacts to upstream water rights holder, PG&E
Infrastructure Requirements[(b)]	• Raw water intake and booster pump structure (18 mgd) • 101,000 feet of 42-inch diameter pipeline from Thermalito Forebay to deliver raw water to proposed water treatment plant • Water treatment plant (18 mgd) and storage facility to treat raw water	• Raw water intake and booster pump structure (18 mgd) • 95,000 feet of 42-inch diameter pipeline from Thermalito Forebay to deliver raw water to proposed water treatment plant • Water treatment plant (18 mgd) and storage facility to treat raw water	• Raw water booster pump (18 mgd) • 26,000 feet of 42-inch diameter pipeline from intake to deliver raw water to proposed water treatment plant • Water treatment plant (18 mgd) and storage facility to treat raw water	• Two radial collector wells (18 mgd) • 31,000 feet of 42-inch diameter pipeline from radial collector wells to deliver raw water to proposed water treatment plant • Water treatment plant (18 mgd) and storage facility to treat raw water	• Raw water intake and booster pump structure (18 mgd) • 6,000 feet of 42-inch diameter pipeline from intake to deliver raw water to PID's WTP • Expand PID's existing WTP by 18 mgd • 83,000 feet of 42-inch diameter pipeline to deliver treated water to the Chico District (by gravity) • Potential in-line hydropower facility
Political and Institutional Considerations	• Potential easement issues (preliminary alignment crosses private properties, primarily pasture)	• Potential easement issues (additional evaluation required to determine existing land uses) • Availability of existing easements are unknown (section between Durham and Chico is a developed b ke path)	• Potential easement issues • Working with Federal authorities • Develop agreement to re-locate place of use • Develop water exchange agreement • Coordination between Federal and State water projects to re-operate the systems under the Coordinated Operations Agreement	• Potential easement issues • Working with Federal authorities • Develop agreement to re-locate place of use • Develop water exchange agreement • Coordination between Federal and State water projects to re-operate the systems under the Coordinated Operations Agreement	• Potential easement issues • Difficult to divert Table A water upstream of Lake Oroville • West Branch Feather River PG&E water rights issues • Requires partnership agreement with PID
Environmental Considerations	• Creek crossings	• Creek crossings	• Impacts to Federally-listed endangered fisheries in the Sacramento River	• Impacts to Federally-listed endangered fisheries in the Sacramento River (anticipated to be less than with a conventional surface water diversion)	• Impacts to Federally-listed endangered fisheries and other wildlife in the upper Feather River watershed • Creek crossings
Operational Considerations	• No identified delivery constraints on timing or quantity of deliveries	• No identified delivery constraints on timing or quantity of deliveries	• Existing issues with pumping from the Sacramento River (e.g., gravel bar) • Coordinate operations with Federal and State water projects • Poss ble restrictions on diversions due to temperature control requirements • Requires an operating agreement	• Potential yield and water quality is dependent on hydrogeologic an geochemical conditions • Coordinate operations with Federal and State water projects • Poss ble restrictions on diversions due to temperature control requirements • Requires an operating agreement	• Treated water supply only available during normal and wet hydrologic years • Coordinate operations with PID • Poss ble restrictions on diversions
Conceptual Conveyance Costs[(c)]	• Capital: $108 M	• Capital: $71 M	• Capital: $20 M	• Capital: $32 M	• Capital: $100 M (excluding potential in-line hydropower facility)
Estimated Schedule	• EIR: 2 years • Design and Right-of Way Acquisition: 2 years • Construction: 2 years	• EIR: 2 years • Design and Right-of Way Acquisition: 2 years • Construction: 2 years	• EIR: 2 years • Design and Right-of Way Acquisition: 2 years • Construction: 2 years	• EIR: 2 years • Design and Right-of Way Acquisition: 2 years • Construction: 2 years	• EIR: 2 years • Design and Right-of Way Acquisition: 2 years • Construction: 2 years
Advantage(s)	• Surface water deliveries do not need to meet CVP temperature control requirements	• Potential to serve the City of Durham • Clear path without dividing most existing farms • Shorter, more direct alignment than Alternative 1 • Surface water deliveries do not need to meet CVP temperature control requirements	• Project would require a much shorter transmission pipeline than alternatives conveying water from Lake Oroville • Potential use of the City's existing sewer alignment • Regional partnership	• Project would require a much shorter transmission pipeline than alternatives conveying water from Lake Oroville • Fewer environmental impacts to the Sacramento River than Alternative 3 • Lower turbidity and organic material will require less capital and O&M costs • Avoid intrusion of any mollusks • Avoid potential sediment transport/deposition issues in Sacramento River	• Cal Water will not have to design, construct or operate a water treatment plant • Regional partnership
Disadvantage(s)	• Rough/difficult terrain • Lengthy pipeline, compared with Alternatives 3 and 4	• Lengthy pipeline, compared with Alternatives 3 and 4	• Potential issues with conventional screened diversion structure from the Sacramento River (e.g., gravel bar) • Reliance on M&T's infrastructure • Surface water deliveries may be curtailed in some dry years to meet CVP temperature control requirements	• More expensive than a conventional screened diversion structure • Potentially lower groundwater levels in adjacent wells • Surface water deliveries may be curtailed in some dry years to meet CVP temperature control requirements	• Other users on West Branch Feather River have senior rights to diversion • Reliance on PID's infrastructure • Treated water supply limited in dry years • Rough/difficult terrain • Lengthy pipeline, compared with Alternatives 3 and 4

(a) The long-term delivery estimate of 11,700 AFY is based on long-term planning studies of the State Water Project by California Department of Water Resources, as documented in the 2009 State Water Project Delivery Reliability Report (DWR, August 2010). Lower estimate of 10,500 AFY is based on discussions with Reclamation staff, in which they indicated that releases during longer-term droughts may need to be curtailed. Therefore, for the purposes of estimating long-term yield, deliveries were assumed to be zero in the second and subsequent years of multiple-year droughts.
(b) Assumes baseload delivery of Table A supply. Under Alternative 5, assumes Cal Water's share of the regional project is sufficient for PID's proposed drought year supply.
(c) Does not include costs to purchase and treat Table A supply or for land acquisition.

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Alternative 2 (Pipeline along the Abandoned Sacramento Northern Railroad from Thermalito Forebay) was selected for further study because it appears to be the easiest surface water project to implement since the diversion will be directly from Lake Oroville. However, Alternative 2 requires a significant length of pipeline along the abandoned Sacramento Northern Railroad to reach the Chico District. Alternative 4 (Diversion from the Sacramento River using Radial Collector Wells) was selected for further study because it significantly reduces the length of pipeline required to reach the Chico District and avoids potential sediment transport/deposition issues in the Sacramento River. However, under Alternative 4, surface water deliveries maybe subject to curtailment in some dry years to meet CVP temperature control requirements. Additional analyses as discussed below will be required to further define Alternatives 2 and 4 before selecting the final preferred alternative for potential design and construction

FINDINGS AND CONCLUSIONS

Based on the work completed to evaluate (1) the projected monthly surface water delivery estimates and (2) the potential surface water supply conveyance projects, a brief summary of the findings and conclusions from each evaluation is provided below.

Projected Surface Water Delivery

Based on the evaluation of several different monthly surface water delivery projections, the baseload delivery option was selected for implementation in the Chico District because it would result in the smallest required WTP capacity. A smaller WTP would reduce project costs especially since actual annual water deliveries from the SWP are typically less than the County's Table A amount; consequently, a larger WTP would not be utilized at full capacity during most years. Therefore, the baseload delivery option was used to establish conceptual facility sizing for surface water and corresponding groundwater needs. However, there would be increased costs associated with water distribution system improvements that are required to deliver large amounts of surface water during the winter months under the baseload delivery option.

Currently, the County, the Solano County Water Agency, Napa County Flood Control and Water Conservation District are litigating to secure area of origin rights to their respective SWP allocation. If successful, the County would be able to receive its maximum annual SWP allocation during any hydrologic year. Until a settlement agreement is negotiated, this evaluation for the Chico District continues to assume that the County's Table A water supply is subject to cut-backs from DWR.

It should be noted that if the raw surface water supply is diverted directly from Lake Oroville, there are no foreseeable limitations to the timing of raw surface water delivery. However, if creek conveyance or a water exchange in the Sacramento River is evaluated, potential surface water diversion constraints will need to be further identified and evaluated.

Preferred Alternatives

Based on an concept-level evaluation of the five preferred surface water supply conveyance projects, the two alternatives selected for further study include Alternatives 2 and 4. As discussed above, Alternatives 2 and 4 appear to combine ease of implementation/operation as well as lower capital costs. In addition, these two alternatives are significantly different approaches to deliver surface water supply to the Chico District (Lake Oroville vs. Sacramento River) and will provide

Cal Water with flexibility as they move forward with selecting a final preferred alternative. As discussed in the next section, additional analyses will be required to further define Alternatives 2 and 4 before selecting the final preferred alternative for potential design and construction.

RECOMMENDED NEXT STEPS

Based on the two preferred alternatives selected for further study, additional analyses including hydrogeologic characterization and field studies for the Sacramento River diversion alternative, a WTP evaluation a pipeline route evaluation, and more detailed cost estimates are needed to provide additional details to help screen and identify the final preferred alternative for potential design and construction. West Yost will work with Cal Water to define work tasks to be completed in 2012.

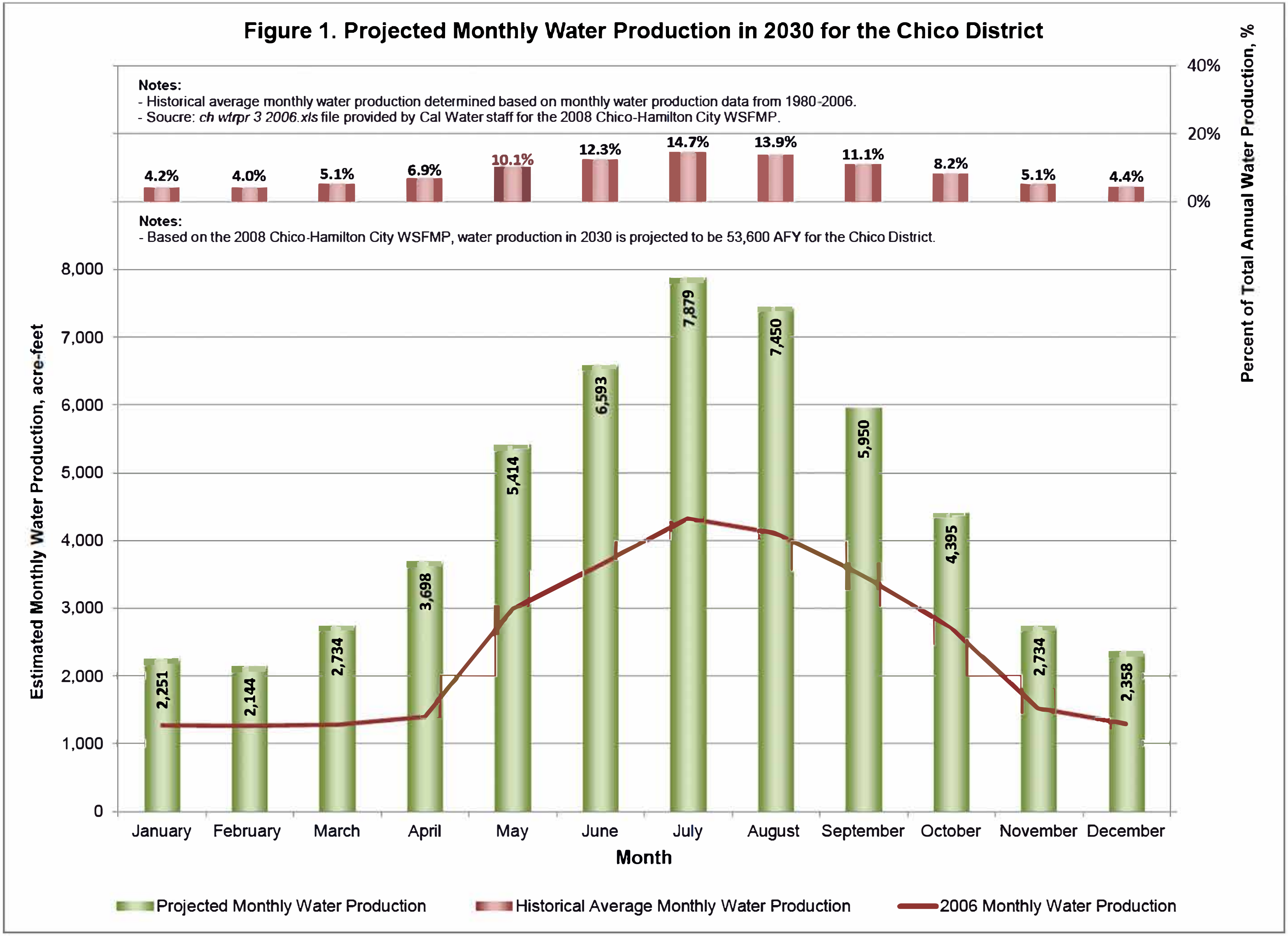
Figure 1. Projected Monthly Water Production in 2030 for the Chico District
Notes:
- Historical average monthly water production determined based on monthly water production data from 1980-2006.
- Soucre: ch wtrpr 3 2006.xls file provided by Cal Water staff for the 2008 Chico-Hamilton City WSFMP.
Notes:
- Based on the 2008 Chico-Hamilton City WSFMP, water production in 2030 is projected to be 53,600 AFY for the Chico District.
4.2%
4.0%
5.1%
6.9%
10.1%
12.3%
14.7%
13.9%
11.1%
8.2%
5.1%
4.4%
2,251
2,144
2,734
3,698
5,414
6,593
7,879
7,450
5,950
4,395
2,734
2,358
Estimated Monthly Water Production, acre-feet
Percent of Total Annual Water Production, %
40%
20%
0%
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
January
February
March
April
May
June
July
August
September
October
November
December
Month
Projected Monthly Water Production
Historical Average Monthly Water Production
2006 Monthly Water Production

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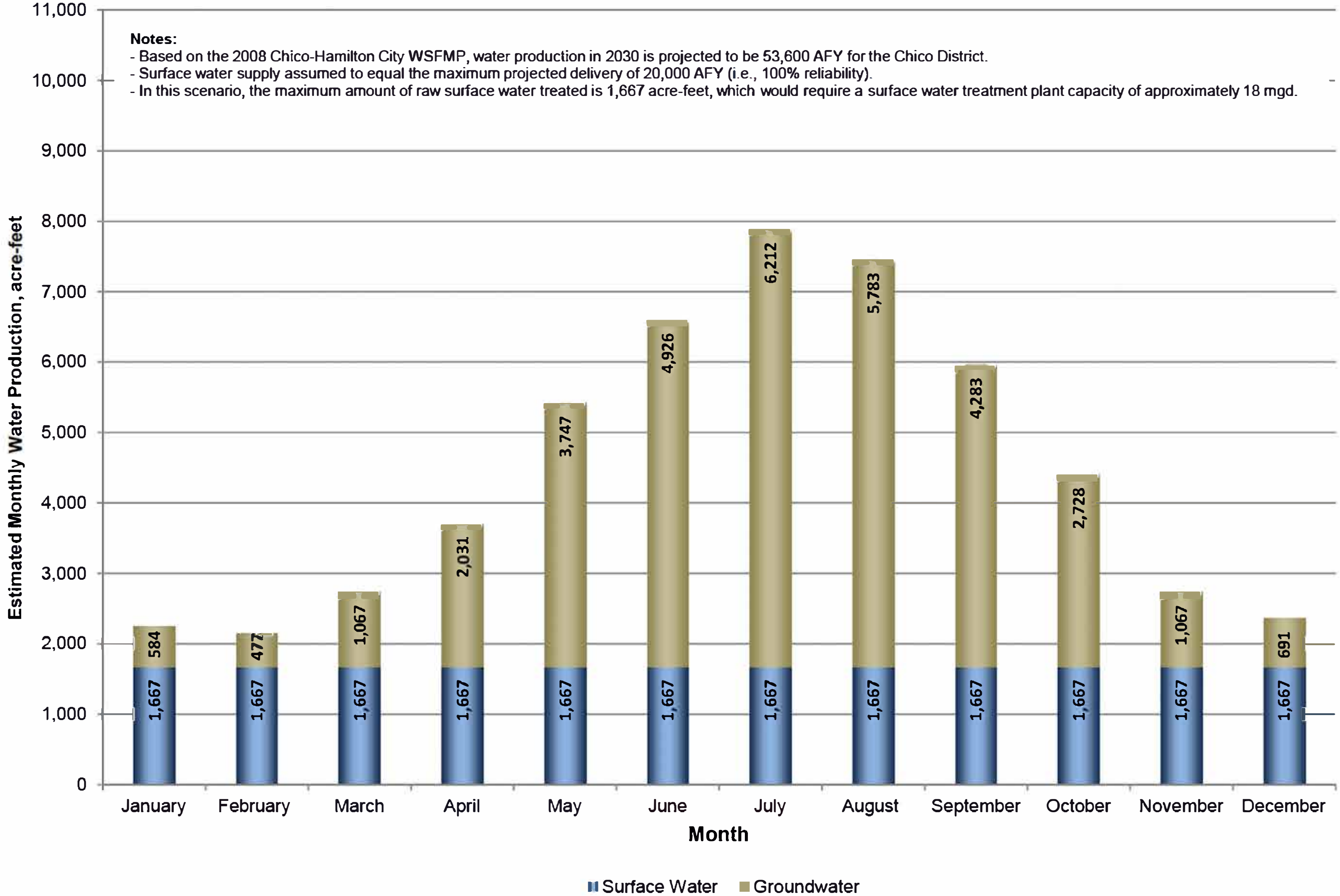
Figure 2. Projected 2030 Monthly Water Production by Supply Source with Baseload Delivery of Treated Surface Water Supply



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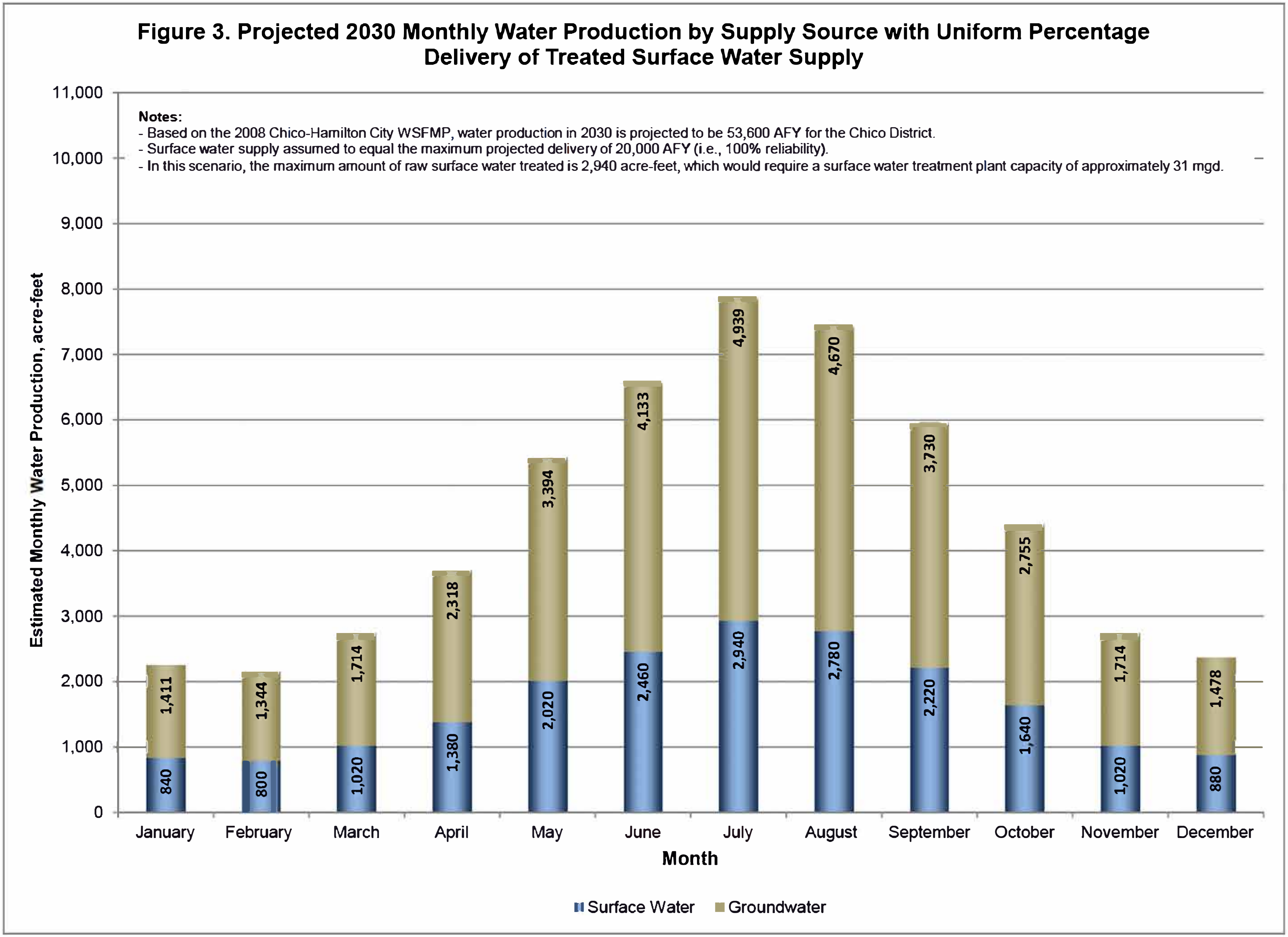

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Confidential Chico District
Surface Water Supply Feasibility Study

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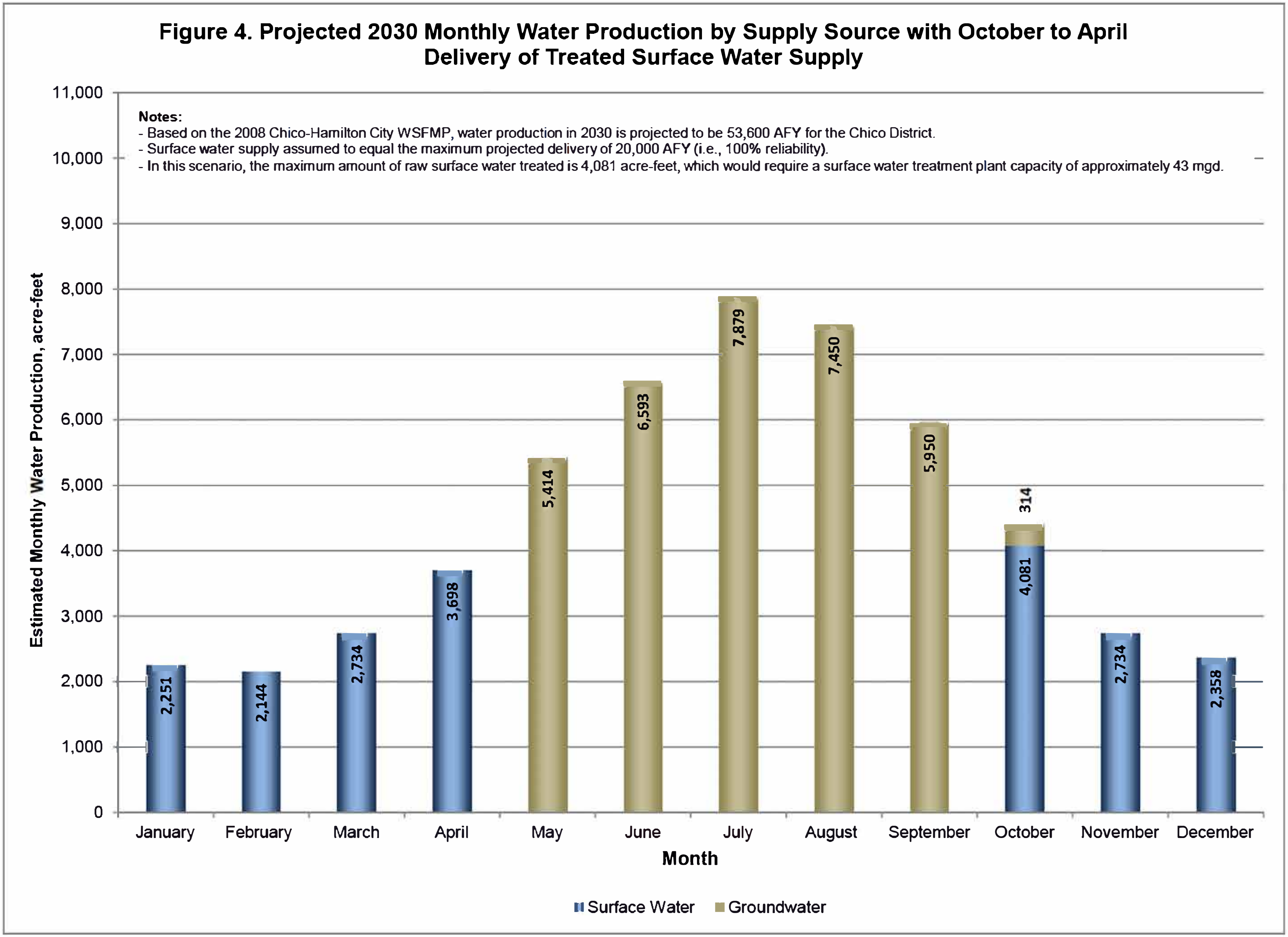
Figure 4. Projected 2030 Monthly Water Production by Supply Source with October to April Delivery of Treated Surface Water Supply
Notes:
- Based on the 2008 Chico-Hamilton City WSFMP, water production in 2030 is projected to be 53,600 AFY for the Chico District.
- Surface water supply assumed to equal the maximum projected delivery of 20,000 AFY (i.e., 100% reliability).
- In this scenario, the maximum amount of raw surface water treated is 4,081 acre-feet, which would require a surface water treatment plant capacity of approximately 43 mgd.
Estimated Monthly Water Production, acre-feet
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2,251
2,144
2,734
3,698
5,414
6,593
7,879
7,450
5,950
314
4,081
2,734
2,358
January
February
March
April
May
June
July
August
September
October
November
December
Month
Surface Water
Groundwater

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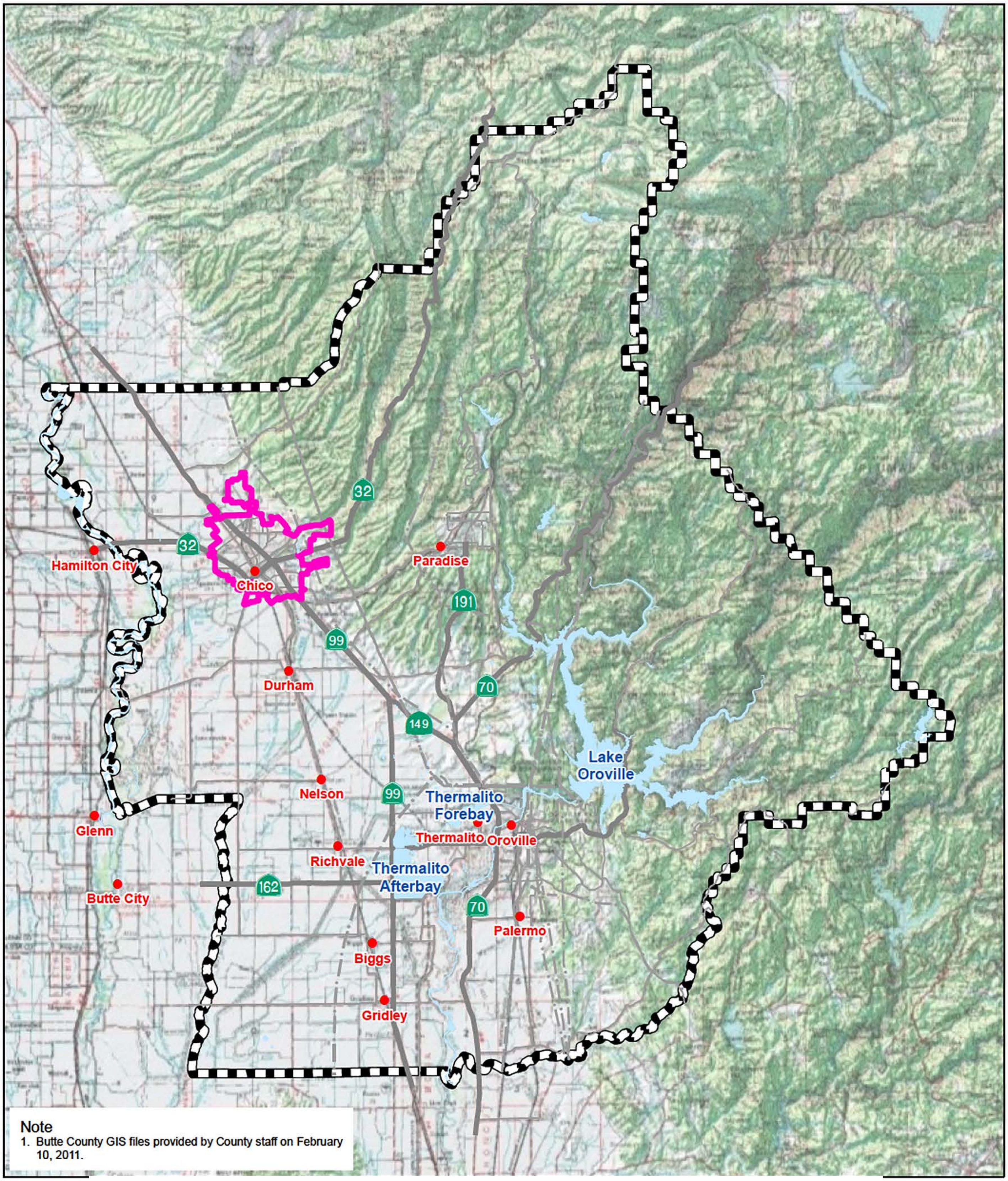

Note
1. Butte County GIS files provided by County staff on February 10, 2011.

LEGEND
Chico District Service Area
Butte County
Water Body

N

0 4 8
Scale in Miles

FIGURE 5

California Water Service Company
Surface Water Supply Feasibility Study

PROJECT LOCATION

WEST YOST ASSOCIATES

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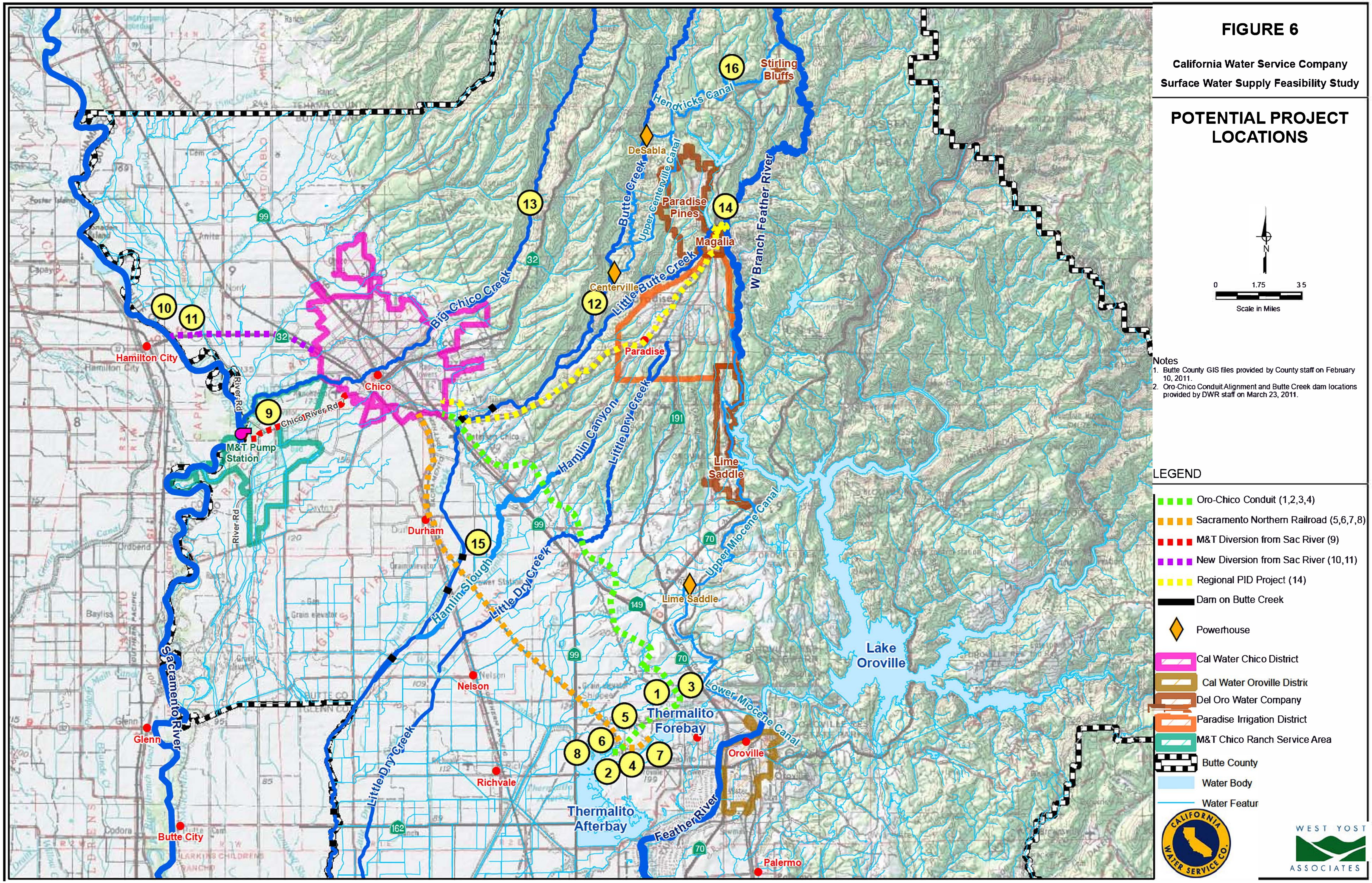

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ATTACHMENT A

Notes from Meetings with the State Water Contractors, DWR and Reclamation

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OVERVIEW

This document describes a conceptual proposal for delivery of a substantial portion of Butte County's State Water Project (SWP) contract surface water supply to Chico, requiring an exchange of water supplies between the Department of Water Resources (DWR) and the U.S. Bureau of Reclamation (Reclamation). We are seeking input on the concept, including identification of key issues, to help guide conceptual development, design, environmental review and implementation.

BACKGROUND

Butte County (County) has an SWP contract supply (Table A amount) of 27,500 acre-feet per year. Historically, the County has used only a small portion of its Table A amount, and the County is seeking in-County users to increase use of its Table A amount. California Water Service Company's (Cal Water's) Chico District (District) provides potable water service to the City of Chico (City) and nearby Hamilton City. Current water use within the District is about 30,000 acre-feet per year, with a projected 2030 demand of about 54,000 acre-feet per year. The District relies solely on groundwater, drawn from several sub-basins of the Sacramento Valley groundwater basin. Although near-term groundwater levels are projected to be stable, the District's Water Supply and Facility Master Plan recommended evaluating supplemental supplies for the District to meet longer-term needs.

Cal Water and the County are preparing a Surface Water Feasibility Study (Feasibility Study) assessing ways to deliver up to 20,000 acre-feet per year of the County's Table A amount to the City, to augment their groundwater supplies. Water would be delivered to the City for treatment and delivery or for groundwater recharge.

One option being considered is a potential exchange of 20,000 acre-feet of the County's Table A amount between DWR and Reclamation that would deliver water released from federal project facilities on the Sacramento River to the City, and release of the same quantity of water from DWR's SWP facilities on the Feather River for use by Reclamation. The advantage of such an exchange is that it would significantly reduce the length of pipeline conveyance facilities needed to bring water to the City (the Sacramento River is less than ten miles west of the City). Other options, which are considering diversions from the Feather River, would require up to 20 miles of pipeline to convey water to the City.

PROJECT DESCRIPTION

Provide up to 20,000 acre-feet per year of the County's Table A amount for diversion from the Sacramento River at a location west of the City. This water would be provided through an exchange between DWR and Reclamation, whereby DWR would release an amount of water into the Feather River from Oroville Reservoir in exchange for a like amount of water provided by Reclamation at the new diversion facility on the Sacramento River.

Areas under consideration for a new diversion facility are along Chico River Road southwest of the City, running north to Highway 32 near Hamilton City. Two types of diversion facilities are being explored: a standard surface water diversion that would pump surface water directly out of the river, and radial collector wells, such as Ranney collectors, that that would be installed in the alluvial aquifer adjacent to the river to collect subsurface flow. Water would be pumped into a

pipeline for conveyance to the City, either to a water treatment plant, directly delivered to customers, or to recharge facilities.

The seasonal pattern of delivery will depend on a number of factors, including:

- whether water is provided for groundwater recharge or directly served to customers;
- hydrologic year type and Table A allocation amount; and/or
- tradeoff and balance between sizing and costs for diversion and treatment facilities and distribution system infrastructure.

Base load operation will be assumed for study purposes with an average daily diversion rate of approximately 18 million gallons per day (mgd) or 28 cubic feet per second (cfs), in a 100 percent Table A allocation year. Seasonal variations in demand may also be considered, with a range in diversion rates of 10 to 30 mgd (15 to 45 cfs), based on variation in monthly demands within the City's water system, again with diversion rates based on a 100 percent Table A allocation year.

POLICY CONSIDERATIONS

Exchange arrangements between DWR and Reclamation are common for a number of reasons that recognize the operational needs of both the SWP and the federal Central Valley Project (CVP). For this proposal, there is a nearby precedent that is the reverse of our proposed exchange. Reclamation has a long-term water supply contract with the Feather Water District (FWD) on the lower Feather River, for delivery of up to 20,000 acre-feet per year of CVP water (Irrigation Contract No. 14-06-200-171-A-LTR1). Reclamation's Sacramento River supplies are delivered to FWD through an exchange with DWR, allowing FWD to divert water from the Feather River, rather than build facilities to divert out of the Sacramento River. The proposed exchange could be implemented under longstanding SWP and CVP operational policies.

The County has had difficulties in making full use of its Table A amounts, although it has always intended to make full use of its contract supplies. Local facility costs have been a major impediment to such use. For a number of years, the County has worked with DWR and its SWP water contractors on interim solutions to postpone the time when the County would be responsible for full payment of its Table A amount, recognizing issues associated with local facility costs. The proposed project, if implemented, would allow the County to take nearly its full Table A amount, and avoid the need for the kinds of interim solutions developed in the past that have either shifted costs to other SWP contractors or required short-term actions by DWR for interim transfer of water from the County to another SWP water contractor. The certainty of the County's Table A amount water deliveries, coupled with associated SWP payments, will avoid the need for future interim measures and the policy/fiscal conflicts that have arisen in the past.

We seek conceptual support from DWR, its water contractors, and Reclamation for this conceptual proposal. Such support, and any specific input, will guide technical studies leading to development of a specific project.

From: Polly Boissevain
Sent: Tuesday, October 25, 2011 3:51 PM
To: Michael J. Pembroke (mpembroke@calwater.com); Bonacich, Peter N.
Cc: Vickie Newlin (VNewlin@buttecounty.net); Steve Macaulay; Charles Duncan
Subject: Chico Table A Study - Meeting with DWR

Sorry - I thought I had sent these out already.

Polly

West Yost and Butte County staff met with representatives from California Department of Water Resources (DWR) on October 13, 2011 to review the Table A study and to discuss the Sacramento River/Feather River exchange alternative, in particular. Meeting attendees:

DWR: Robert Cooke, Chief State Water Project Analysis Office, Craig Trombly, Chief, Project Water Management, Gwen Knittweis Scholl, Chief, Water Contracts Branch, and Nancy Quan, Chief, Program Development and Water Supply and Transfers Butte County: Vickie Newlin, Paul Gosselin (by phone)
West Yost: Polly Boissevain, Steve Macaulay

We arrived to find that there was a copy of the Cal Water Chico District 2010 Urban Water Management Plan printed out and sitting on the table. It was clear that Rob Cooke had perused the document and was generally familiar with the Chico District from that review.

Steve Macaulay provided an introduction, with an overview of the concept, and a brief summary of our meeting with the State Water Contractors. Polly gave background information on the origin of the current project, discussing the 2007 Water Master Plan, and the current study. Vickie summarized County activities regarding taking action on using its Table A supply. She handed out copies of the County’s Action Plan for the long-term use of Table A water that was adopted by the Butte County Board of Supervisors in October 2010.

Rob Cooke asked several questions to get a better understanding of Cal Water’s need for surface water. Vickie, Steve and Polly talked about how the need in Chico is a long term need, but that Cal Water is being proactive on planning for water supply to be in front of the issue.

Implementation of an exchange would likely be through a long-term operational exchange agreement. Some of the specific items that would need to be addressed include: where is the point of transfer, the names and locations of water exchange parties, and the place of use for the exchange water. West Yost can follow up with Craig to discuss the necessary steps that would be required.

Members of DWR attending the meeting are supportive of the project. Rob noted that from DWR’s standpoint, it absolutely makes sense to consider this alternative in the feasibility study, and offered DWR’s assistance to the County and Cal Water. Rob also provided an organizational chart for the Bureau of Reclamation, identified the appropriate contact and said that he has

already had an initial
conversation and that the Bureau is also supportive of the project.

From: Polly Boissevain
Sent: Wednesday, November 09, 2011 1:25 PM
To: Michael J. Pembroke (mpembroke@calwater.com); Bonacich, Peter N.; Tom Salzano (tsalzano@calwater.com)
Cc: Steve Macaulay; Vickie Newlin (VNewlin@buttecounty.net); Charles Duncan
Subject: Chico Table A Study - Meeting with U.S. Bureau of Reclamation

On October 26, 2011, Steve Macaulay, Polly Boissevain and Vickie Newlin met with Bureau of Reclamation (Reclamation) staff Rich Robertson, Chief, Water and Lands Division, Northern California Area Office and Natalie Wolder, Repayment Specialist.

Steve Macaulay and Polly Boissevain provided an overview of the overall study, the Sacramento River exchange concept, and a summary of the meetings that we had with the State Water Contractors and the Department of Water Resources (DWR).

Rich indicated that the exchange would be a very straightforward contract arrangement. On the contractual side of things, the exchange would be similar to other operations that the Central Valley Operations office is already doing. Ultimately, the exchange would be handled under the Coordinated Operating Agreement between Reclamation and DWR. Rich noted that environmental issues could be a significant challenge, since the federal fishery agencies are concerned with any proposed actions that could affect flows and diversions in the Sacramento River system.

Natalie noted that it would be important to be able to demonstrate that there is a basis for the rights to use the water, and that the exchange does not involve water for which use has not been historically established. She said her measure for this is that there is “real water” and not “paper water”, which is the test Reclamation and DWR use for water transfers. The team noted that, unlike a transfer, this would be an exchange, and that historically, water not used by Butte County has either been transferred to others, such as the Palmdale Water District transfer, or turned back to the overall pool for allocation to other SWP water contractors. In addition, the team noted that this is a delivery of a State Water Project contract supply, and thus has the underpinning of Butte County’s SWP water supply contract.

On the environmental side, although the flow quantities are small, Rob believes that Reclamation’s environmental staff and US Fish and Wildlife Service would be concerned about potential for fishery impacts due to the diversion. Some within the environmental regulatory community take the position that any diversion, no matter how small, would have problematic adverse impacts. Rob suggested that we talk with Jeff Sandberg of the Technical Services Center within Bureau of Reclamation, to better understand the specifics of the operational issues.

Rich also noted that due to budgeting issues, Reclamation will also want a commitment to pay
for analysis and studies, should the project move forward. This could involve contractual
matters, any technical analysis or environmental studies. Reclamation will only provide limited
consultation without seeking remuneration for its staff time.

West Yost will follow up with Jeff Sandberg to set up a meeting to review environmental and
operational issues.

Polly Boissevain, P.E.
Engineering Manager
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From: Polly Boissevain
Sent: Tuesday, December 13, 2011 7:37 PM
To: Pembroke, Michael
Cc: Vickie Newlin; Bonacich, Peter N.; Charles Duncan; Steve Macaulay; Amy Kwong; Tom Salzano (tsalzano@calwater.com)
Subject: Update, Meeting with Bureau of Reclamation regarding Cal Water Chico project

Mike –

I wanted to forward Steve Macaulay's notes regarding his conversation with Jeff Sandberg at the Bureau of Reclamation Joint Operations Center. We contacted Jeff to get more information on the potential environmental impacts that were flagged during our earlier meeting with Richard Robertson in the Bureau's Willows office.

Based on Steve's conversation with Jeff, there could be periods, in dry years following several dry years, in which project diversions could not be made due to their impact on the Bureau's Sacramento River temperature control operations and CVP project deliveries. However, these restrictions do not appear to constitute a fatal flaw for the project.

Let me know if you have any questions.

Thanks.

Polly

From: Steve Macaulay
Sent: Tuesday, December 13, 2011 11:50 AM
To: Polly Boissevain
Subject: Update, Meeting with Bureau of Reclamation regarding Cal Water Chico project

On December 12, 2011 I talked by phone with Jeff Sandberg (916-979-2707), Bureau of Reclamation operations staff at the Joint Operations Center in Sacramento. Jeff had earlier discussed our proposed project with Richard Robertson in their Willows office, with whom we met on October 26. The reason for the call was to understand Reclamation's potential Central Valley Project operational concerns with the exchange of State Water Project water supplies from the Feather River to the Sacramento River.

Jeff had previously confirmed his operational understanding of the proposed water exchange in a recent discussion with John Lehigh, his counterpart at the Department of Water Resources (DWR, State Water Project Operations). They both agreed the exchange could be accommodated as part of the CVP-SWP Coordinated Operations Agreement.

Jeff's only concern about the project was with regard to potential impacts on the ability of the CVP to meet temperature control requirements on the Sacramento River, which are in place to protect salmon migration and survival. The temperature control point on the Sacramento River is at

Wilkins Slough,
located in the stretch of River between Hamilton City and the confluence with the Feather River, just
north of Knights Landing. Jeff said that a reduction in flow of even 30 cubic feet per second in that
stretch of the Sacramento River could, under some circumstances, make it difficult for the Bureau to
meet the requirements without releasing additional cold water from Shasta Dam. The Bureau would be
unwilling to make such releases as this would impact CVP water supplies. It would also reduce CVP
operational flexibility to meet the same regulatory requirement if dry conditions persisted.

The conditions under which this limitation could apply are limited, but could significantly reduce the
period of time in some months of some years (primarily dry years following several dry years) that the
project could divert water from the Sacramento River. Jeff said that it is related to the size and
temperature of the pool of water behind Shasta Dam. Operational limitations could be expected
following several years of reservoir drawdown without refilling of Lake Shasta. This circumstance has
happened at least once in the past 20 years, and is difficult to forecast. Jeff said that his office could do
some temperature modeling to see how significant a problem this might be, after we had determined
whether the proposed exchange might make sense from an economic and water supply standpoint and
decided to pursue this as a real option.

Steve

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ATTACHMENT B

Evaluation of Diversion Facility Options for Sacramento River Diversion Memo

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MEMORANDUM

DATE: December 21, 2011 Project No.: 436-06-11-13

TO: Michael Pembroke, Cal Water

CC: Peter Bonacich, Cal Water
Tom Salzano, Cal Water

FROM: Charles Duncan, R.C.E. #55498
Gerry Nakano, R.C.E. #29524
Elizabeth Drayer, R.C.E. #46782

REVIEWED BY: Steve Macaulay, R.C.E. #21188

SUBJECT: Cal Water Chico Surface Water Supply Feasibility Study
Evaluation of Diversion Facility Options for Sacramento River Diversion

INTRODUCTION AND PURPOSE

One of the water supply alternatives being evaluated for the California Water Service Company Chico District (Chico District) is a potential surface water exchange between the U.S. Bureau of Reclamation (Bureau) and the California Department of Water Resources (DWR). Under the potential exchange, up to 20,000 acre-feet per year (AFY) of Butte County's State Water Project (SWP) Table A water supply would be diverted from the Sacramento River near Hamilton City upstream of the confluence with the Feather River, and DWR would release a like amount of water down the Feather River to where it joins the Sacramento River. The potential exchange would need to be approved by DWR and the Bureau, as well as other stakeholders, and is described in a separate memorandum.

The purpose of this memorandum is to describe the options for diverting the exchanged water from the Sacramento River near Hamilton City for transmission, treatment and delivery to the Chico District (assuming that the potential surface water exchange described above can be negotiated and implemented). This memorandum compares a conventional screened surface water intake diversion structure to a radial collector well (commonly referred to as a Ranney Collector, which is the name of a company that designs and constructs such wells), and discusses the advantages and disadvantages of each. This memorandum also describes the potential approval and permitting requirements associated with the construction and operation of a diversion, as well as recommended next steps.

TYPES OF SURFACE WATER DIVERSION STRUCTURES

Conventional Screened Surface Water Intake Diversion Structure

A conventional surface water intake diversion structure is constructed in the river parallel to the river flow and consists of an intake structure and fish screens to protect juvenile anadromous and resident fish species. Design and construction of the diversion is determined based on desired capacity of the diversion, maximum approach velocities, sweeping velocity and maximum opening size. Pumps are provided within the intake structure to pump the diverted water from the river to a transmission main for delivery to a treatment plant and then to the distribution system. The intake structure typically includes an intake cleaning mechanism to remove debris which can accumulate on the fish screen and a sediment control system to remove silt and sand that accumulates on the floor of the intake structure.

Radial Collector Well

<u>What is a Radial Collector Well?</u>

A radial collector well is an alternative to a conventional vertical well, and may be considered as a potential alternative to a conventional screened surface water intake. Radial collector wells are generally located near a river and are comprised of a vertical large-diameter reinforced concrete shaft (or caisson) with horizontal lateral well screens projected out into the aquifer to collect subsurface water (see Figure 1). Most radial collector well caisson internal diameters vary from 13 to 24 feet, depending on the anticipated yield, with 18- to 30-inch wall thicknesses, depending on the depth below groundwater and the potential for buoyancy effects. Depths depend on site-specific hydrogeologic conditions.

As an alternative to a conventional screened intake, radial collector wells are typically installed in alluvial aquifers adjacent to a river with laterals often extending beneath the river, taking advantage of the natural filtering process referred to as riverbank filtration (RBF). Numerous case studies have demonstrated the benefits of RBF to remove sediment carried by the river at high flow. It will also prevent the intrusion of any mollusks that may come to inhabit the river (an increasingly serious problem with conventional surface water intakes). Through RBF, organic material is also removed as percolating water passes through the river bed and shallow aquifer material before entering the laterals. Additionally, organic compounds present in the surface water (i.e., agricultural chemicals) would likely be removed through sorption to clay particles and organic material present in the river bottom and shallow underlying

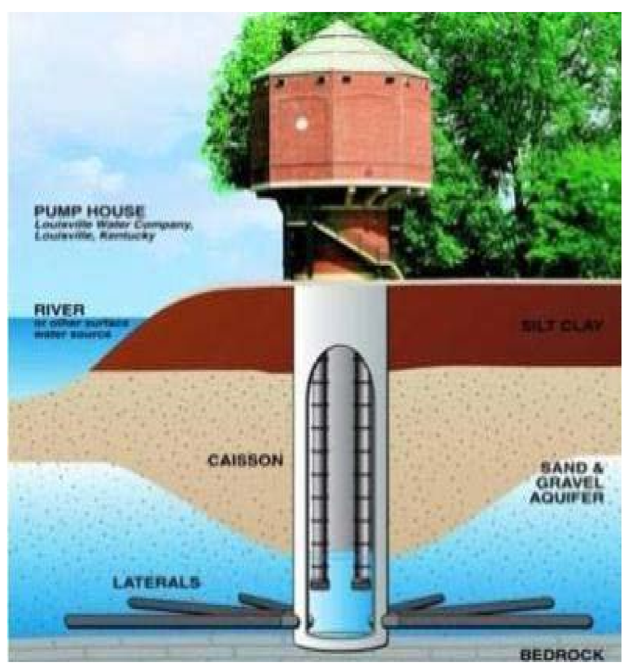


Figure 1. Schematic of a Typical Radial Collector Well

sediments before entering the laterals. However, removal of organics is site-specific and a function of both the depth of laterals below the river bottom and the soil composition and texture in the soil column between the river bed and laterals.

Advantages of Radial Collector Wells as Compared to Conventional Surface Water Intakes

Use of a radial collector well instead of a conventional screened surface water intake could provide the following advantages for the Chico District:

- The water collected is not subject to the extremes in sediment load that occur in the river during peak flow periods;
- Should nuisance mollusks infest the river, they cannot enter the system;
- Organic material in the river water is removed as percolating water passes through the river bed and shallow aquifer material before entering the laterals;
- Turbidity and pathogen removal can also be significant; specifically, there may be a reduction in *Cryptosporidium* and *Giardia;* and.
- Bar and channel migration in the Sacramento River will not adversely impact surface water intake capacity as has been the case at M&T Ranch (see further discussion below).

As a result, the radial collector well could reduce the preliminary treatment required in the water treatment process. Additionally, potential debris accumulation and physical damage during flooding, commonly associated with conventional surface water intakes, would be greatly reduced or eliminated.

Because the water delivered by radial collector wells may be influenced by surface water, surface water treatment rules may apply. However, operation of the water treatment plant could be simplified because the turbidity will be lower and much less variable than with a typical raw surface water supply.

Radial collector wells generally result in few environmental impacts in that no in-water construction would be required, and there would be no impacts on fish associated with the intake. There would also be no impacts associated with a structure in the river, such as downstream erosion, interference with recreational boating or impacts on flood carrying capacity.

Disadvantages of Radial Collector Wells as Compared to Conventional Surface Water Intakes

General disadvantages of using a radial collector well instead of a conventional surface water intake include the following:

- Water entering the laterals could be a combination of both native groundwater and surface water. For this reason, the resulting TDS of produced water could be higher than the TDS of river water alone;
- The water collected may still be subject to the treatment requirements of the Surface Water Treatment Rule (see further discussion under Potential Treatment Requirements);

- Increased energy consumption resulting from higher lift costs;
- Operation of a radial collector well system could result in lower groundwater levels in adjacent public or private wells; and
- Radial collector wells have higher redevelopment costs than a conventional surface water diversion. Like other groundwater wells, redevelopment of radial collector wells is required to maintain production rates which decline over time due to factors such as siltation and biofouling. The frequency of redevelopment is on the order of years and is site-specific.

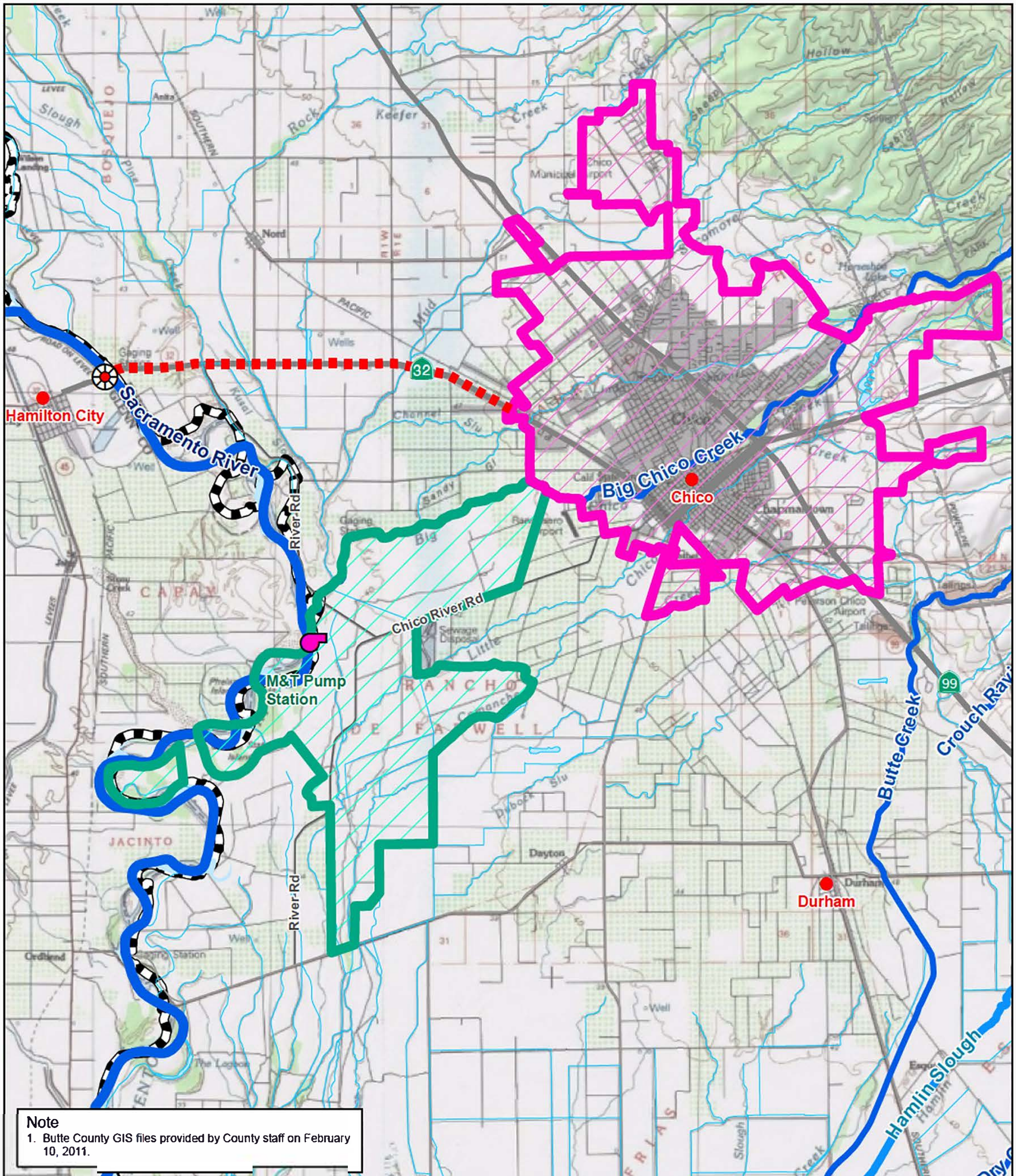
M&T CHICO RANCH'S EVALUATION OF RADIAL COLLECTOR WELLS

M&T Chico Ranch and Rancho Llano Seco (M&T/Llano Seco), located southwest of the Chico District, currently has an existing 150 cubic feet per second (cfs) conventional surface water diversion downstream of the confluence of Big Chico Creek and the Sacramento River, on the east bank of the Sacramento River at river mile 193 (see M&T Pump Station shown on Figure 2). An encroaching gravel bar located in the river channel near the pumping plant intake structure is migrating downstream, threatening operation of the structure. As a result of sediment deposition surrounding the pumping plant intake, existing fish screens are no longer receiving sufficient sweeping river flows (parallel to the fish screen) and are inconsistent with applicable criteria by the National Marine Fisheries Service (NMFS) and the California Department of Fish and Game (CDFG).

Due to the on-going issues with its existing surface water diversion facility, M&T/Llano Seco has evaluated the potential for installing radial collector wells on the Sacramento River as an alternative to its existing surface water diversion. The proposed radial collector well system for M&T/Llano Seco would be located in the same general vicinity of the existing surface water diversion to minimize the distance between the radial collector well system and M&T/Llano Seco's existing water transmission facilities.

In 2005, Montgomery Watson Harza (MWH) performed an evaluation of radial collector well suitability as an alternative water intake for M&T/Llano Seco[1]. The MWH evaluation was based on results from a 20-inch-diameter test well (depth of 110 feet) and six 2-1/2-inch monitoring wells (various depths ranging from 80 to 135 feet). The test well location was determined based on the potential location for radial collector wells (about 1,000 feet south of the confluence of Big Chico Creek and the Sacramento River) and the monitoring wells were located in north-south and east-west trending arms extending to the north and east of the test well (see Figure 3).

[1] Aquifer Test DRAFT Report for the Ducks Unlimited M&T Chico Ranch and Rancho Llano Seco Fish Screen Project, prepared for Ducks Unlimited, Inc., prepared by Montgomery Watson Harza, January 21, 2005.



Note
1. Butte County GIS files provided by County staff on February 10, 2011.

LEGEND

- Proposed Diversion Location
- Proposed Transmission Main
- Cal Water Chico District
- M&T Chico Ranch Service Area
- Butte County
- Water Feature
- Water Body

0 1 2
Scale in Miles

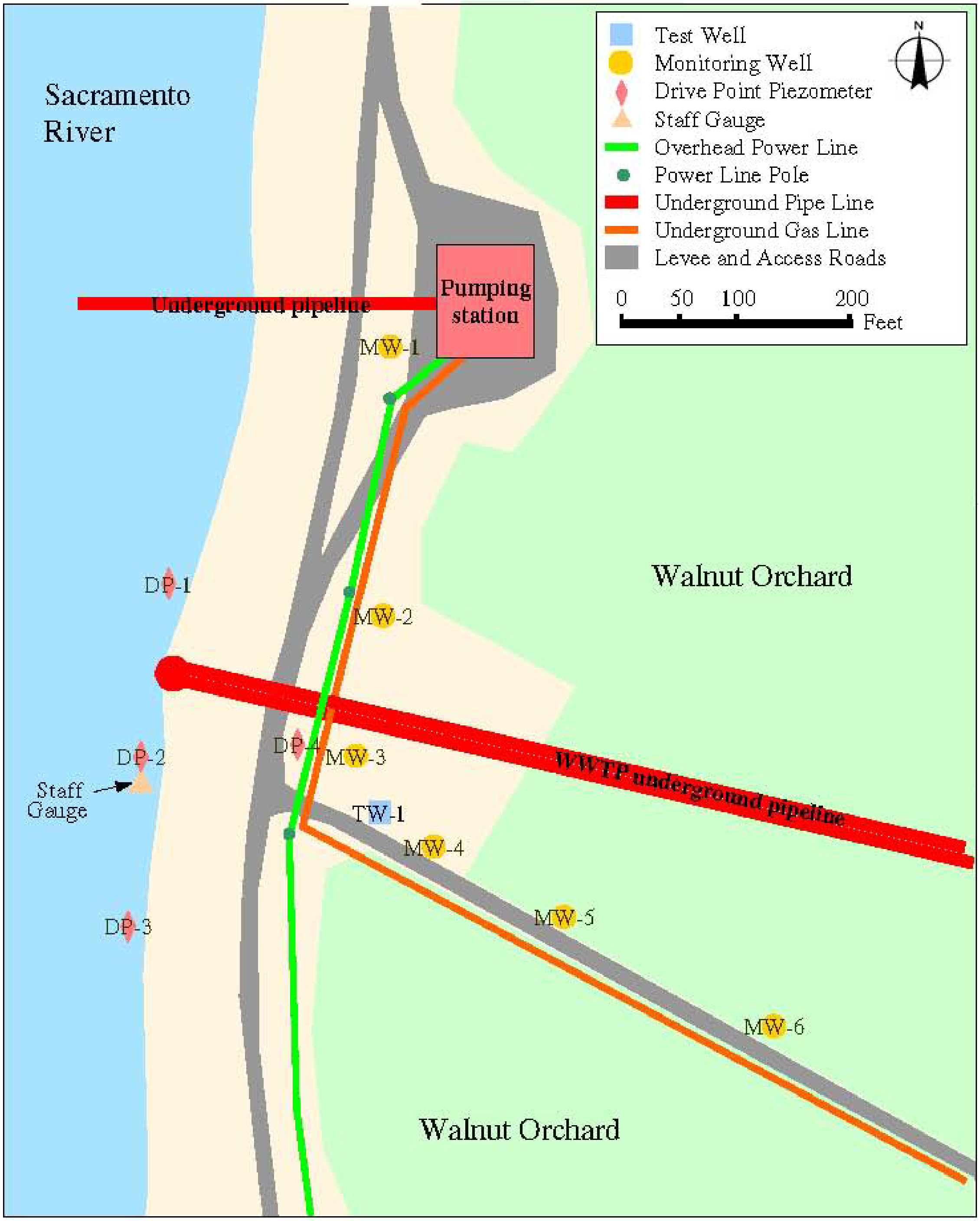
N

FIGURE 2

California Water Service Company
Surface Water Supply Feasibility Study

PROPOSED DIVERSION LOCATION

WEST YOST ASSOCIATES



Source Figure 1-2, Aquifer Test DRAFT Report for the Ducks Unlimited M&T Chico Ranch and Rancho Llano Seco Fish Screen Project, prepared for Ducks Unlimited, Inc., prepared by Montgomery Watson Harza, January 21, 2005.

Figure 3. Location of M&T/Llano Seco Test Well and Monitoring Wells

Key findings of the MWH evaluation included the following:

- Surface water and groundwater level trends strongly suggested interconnection between the Sacramento River and shallow aquifer system (*e.g.*, groundwater level moves up and down in direct response to fluctuations in Sacramento River level changes);
- Spinner logging indicated that the greatest production volumes are contributed from the aquifer adjacent to the top of well screen (45.5 to 50 feet below ground surface);
- Temperature readings, water quality sampling, and water levels indicated that the river is a "gaining stream" (*i.e.*, the river is gaining water from the groundwater aquifer); and
- Aquifer testing indicated that the shallow groundwater system is a sustainable source of water supply and long-term drawdown and overdraft of the aquifer is not anticipated.

Based on these findings, the recommended radial collector well design for M&T/Llano Seco was as follows:

- The central concrete caisson would have an inside diameter of 16 feet and a total depth of 105 feet;
- The caisson would extend 10 feet above ground for flood protection;
- Twelve 12-inch diameter laterals would be installed at the base of the caisson (95 feet below grade) in a radial pattern; laterals would average 200 feet in length;
- Caisson would be capped with a 24 by 24 foot top slab with handrail; and
- Two pumps with soft-start motors would be mounted on the slab, and operated with manual controls. Pump discharges would be manifolded together with appropriate check valves and flow meters.

It was estimated by MWH that an individual radial collector well with this design at this location in the Sacramento River would yield approximately 14,000 to 22,000 gallons per minute (gpm). The 14,000 gpm yield assumes no source of induced infiltration, while the 22,000 gpm yield assumes induced infiltration. Based on M&T/Llano Seco's water supply needs, four to five collectors of similar size would be required to achieve a total desired water withdrawal of 150 cfs.

The cost for each radial collector well was estimated by MWH in subsequent studies to be about $6 million (including contingency, engineering, administrative and legal costs). The estimated cost for associated pipelines was estimated to be about $2.7 million. Therefore, the total cost for a system with four collectors to provide the desired diversion of 150 cfs would be about $26.6 million.

RECOMMENDED DIVERSION FACILITY FOR CHICO DISTRICT

The potential yield of radial collector wells in the Sacramento River at the proposed Chico District diversion point in the vicinity of Hamilton City (see Figure 2) will need to be evaluated based on the site-specific hydrogeologic conditions at the proposed diversion point, and may or

may not be similar to the findings of the M&T/Llano Seco evaluation which is located several miles downriver. As described below under *Next Steps*, a detailed evaluation of site-specific hydrogeologic conditions will be required to assess the feasibility, anticipated yield and proposed design of the radial collector wells for the Chico District diversion. However, for initial discussion purposes we have assumed that the hydrogeologic conditions are similar to those found in the M&T/Llano Seco evaluation.

Based on the Chico District's water supply need of about 20,000 AFY, and assuming a baseload delivery operation where the surface water supply will be and delivered evenly over twelve months (averaging about 28 cubic feet per second (cfs) or about 12,400 gallons per minute (gpm)), only one radial collector well similar to the M&T/Llano Seco proposed design and anticipated yield may be required. However, for redundancy and operational flexibility, a minimum of two radial collector wells (each with a capacity of approximately 20 to 25 cfs) would likely be recommended. Although full-time operation of two radial collector wells may provide more capacity than required by the Chico District, it may be beneficial to either run one radial collector well full-time with the other as a back-up, or to run both radial collector wells on a part-time basis.

Under this baseload operations scenario, a 42-inch-diameter transmission pipeline and an 18-mgd pump station would be required to convey the diverted supply from the proposed Sacramento River diversion point to the Chico District (assuming an average flow rate of about 12,400 gallons per minute (gpm) at a velocity of 3 feet per second). The recommended alignment of the transmission pipeline would likely follow Highway 32 west from the Sacramento River to the Chico District distribution system (see Figure 2). The length of the transmission pipeline would be approximately 6 to 7 miles, depending on the location of the connection to the Chico District's distribution system.

POTENTIAL TREATMENT REQUIREMENTS

The required level of treatment for the water supply to be diverted from the Sacramento River will depend on the type of diversion structure to be constructed, and the classification and quality of the diverted water.

If the proposed diversion is constructed as a conventional screened surface water intake, treatment will be required to comply with the filtration and disinfection requirements of the Surface Water Treatment Rule (SWTR) and the Long-Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR). With a conventional screened surface water intake, the diverted water quality will be subject to the naturally occurring and seasonal water quality variances in the Sacramento River. While the water quality in the Sacramento River is generally good, the river water is subject to water quality changes as a result of winter storms and runoff events which can impact turbidity of the diverted water and can impact the ability to efficiently treat the diverted water.

As described above, one of the key advantages of radial collector wells is the water quality benefits that are associated with the radial collector well design and construction. With a radial collector well diversion, the design and operation of the water treatment plant could be simplified because the turbidity of the diverted water will be lower and much less variable than with a typical raw surface water supply. However, treatment of water diverted by a radial collector well will

depend on California Department of Public Health's (CDPH) classification of the water supply being diverted. If the water supply is classified as "groundwater", the water supply would be exempt from the filtration and disinfection requirements of the SWTR and the LT2ESWTR. However, if the water supply is classified as "groundwater under the direct influence of a surface water", it would be subject to the filtration and disinfection requirements of the SWTR and LT2ESWTR similar to that of a conventional screened surface water intake diversion.

The classification of the water supply being diverted using a radial collector well is evaluated on a case-by-case basis by CDPH based on site-specific hydrogeologic conditions, design of the radial collector well and the results of extensive water quality analyses. Based on the M&T/Llano Seco study, the Sacramento River is a "gaining stream" (*i.e.*, the river is gaining water from the groundwater aquifer). Consequently, it is possible that water collected by a radial collector well system may be classified as "groundwater," and may therefore only require minimal treatment (*e.g.*, disinfection); however, this finding would need to be substantiated and ultimately approved by CDPH. However, based on other recently constructed radial collector wells by other water agencies in California, it is more likely that CDPH will classify the supply as "groundwater under the direct influence of a surface water" and will require more conventional surface water treatment.

POTENTIAL PERMIT AND APPROVAL REQUIREMENTS

Table 1 lists the potential permits and approvals that may be required for a diversion on the Sacramento River. As shown, the required permits and approvals may vary depending on the type of diversion to be constructed.

Communications and/or meetings with each of these potential permitting agencies, and possibly others, will be required to determine the applicable review process and confirm required approvals and permits. Depending on specific design elements of the proposed diversion, approvals and/or permits from some of these agencies may not be required.

RECOMMENDATIONS

Based on this preliminary evaluation of the potential diversion options for the Chico District, West Yost recommends that the Chico District further evaluate the feasibility of radial collector wells for the proposed Sacramento River diversion. Even though radial collector wells are typically more expensive than conventional surface water intakes, the benefits associated with radial collector wells (including no in-water construction, no impacts to fish, more uniform water quality), and the difficulties that M&T/Llano Seco have had with their conventional surface water intake, may offset the additional construction costs associated with the radial collector wells. Furthermore, as described above, the design and operation of the water treatment plant could be simplified (and capital and operation and maintenance costs therefore reduced) because the turbidity of the diverted water will be lower and much less variable than with a typical raw surface water supply.

As described above, further studies will be required to evaluate the feasibility and potential design and construction of radial collector wells at the Chico District's proposed diversion location. Recommended next steps for these additional studies are described below.

Table 1. List of Potential Required Approvals and Permits	
Permitting Agency/Permit	Description
California Department of Public Health (CDPH)	CDPH will need to approve the water supply source as being suitable for potable water use and will determine what type of treatment will be required. For a conventional surface water intake diversion, treatment will need to comply with the SWTR and the LT2ESWTR. Treatment requirements for a radial collector well diversion will depend on CDPH's classification of the source water. If the source water is classified as "groundwater", minimal treatment would likely be required (*e.g.*, disinfection). However, if the source water is classified as "groundwater under the direct influence of a surface water", filtration may also be required to comply with the SWTR and LT2ESWTR.
U.S. Army Corps of Engineers (USACE) Clean Water Act (Section 404 Permit)	Issued for the placement of dredged or fill materials into waters of the United States, including wetlands, below the Ordinary High Water Mark (OHWM).
USACE Rivers and Harbors Act Section 10 Authorization (Section 10 Permit for structures in a navigable waterbody)	Issued for the placement of structures, or work (including discharge of dredged or fill materials and excavation) in, above, or below navigable waters that could obstruct navigability in such waters. Construction of a conventional surface water intake in the river would have more impacts to the river than radial collector wells.
Regional Water Quality Control Board (RWQCB) Clean Water Act Water Quality Certification (Section 401 permit)	Issued to ensure that project activities will not result in adverse effects to water quality as defined by the Regional Water Quality Control Board. Water Quality Certification is required when a Section 404 permit will be issued for a project.
California Department of Fish and Game (DFG) Streambed Alteration Agreement (Section 1602 permit)	Issued for projects that would affect the bed, channel, or banks of a stream, river, or lake, or the adjacent floodplain to the landward extent of riparian vegetation. Typically also considers adverse effects to state-listed wildlife species and proposed minimization measures for those effects. Construction of a conventional surface water intake in the river would have more impacts to the river than radial collector wells.
U.S. Fish and Wildlife Service (USFWS) / National Marine Fisheries Service (NFMS) Endangered Species Act Take Authorization (Section 7 "Biological Opinion" or Section 10[a] "take permit")	Issued for adverse effects to federally listed plant and wildlife species.
DFG California Endangered Species Act (CESA) Take Authorization (Section 2080.1 or 2081)	Issued for adverse effects to state-listed plant and wildlife species.
California State Reclamation Board Encroachment Permit	Issued for projects that would modify the channels, levees, or designated floodways of the Sacramento and San Joaquin rivers and their watersheds. Construction of a conventional surface water intake in the river would have more impacts to the river than radial collector wells.
RWQCB National Pollutant Discharge Elimination System (NPDES) permit	Issued for the discharge of waste and pollutants into surface waters. Issued to maintain the quality of surface waters and ensure that project actions do not reduce the quality of the water.
California State Lands Commission Land Use Lease	The California State Lands Commission has state jurisdiction over the beds of navigable waterways such as the Sacramento River. A land use lease must be obtained from the Commission for any project that encroaches on such land.
Butte County Building Department	The Butte County Building Department may need to approve portions of the project. The need for County review will depend on the final design and discussion with the County Building Department regarding application of County code to a project of this type.

Source: Sacramento River Watershed Program website: http://www.sacriver.org/watershed/permitguide/permits/

NEXT STEPS

Assuming that a water supply exchange agreement can be negotiated between the Bureau and DWR to allow for the Chico District to divert water from the Sacramento River, determining whether radial collector wells are a feasible solution for the Chico District will require field studies at the proposed point of diversion (*e.g.*, Sacramento River near Hamilton City). These studies are necessary to gain additional understanding of the hydrogeologic conditions, probable well yield and water quality from the proposed radial collector wells at that specific location. The primary goals of these field studies would be to identify the stratigraphic sequence that would be penetrated by radial collector wells, and estimate the hydraulic conductivity of the major units in this stratigraphic sequence, the yield of a future radial collector well and expected water quality. It is anticipated that field studies would include the following components.

1. A test boring would be drilled to an approximate depth of 100 feet as close as possible to the site of the proposed radial collector wells. Samples would be collected from the drill cuttings at ten-foot intervals and at significant changes in sediment type. These samples would be logged by an experienced hydrogeologist using the Unified Soil Classification System Visual-Manual Procedure, and selected samples would be analyzed for grain size distribution by sieve testing. The test boring would be logged by a qualified geophysical contractor using short- and long-normal resistivity, single point resistivity and spontaneous-potential logging tools. This task would result in information on the stratigraphic sequence and the distribution of relative permeability with depth in the vicinity of the proposed radial collector wells.
2. A test-production well would be constructed in the test boring. The well would be designed based on the lithologic and geophysical logs and sieve test results obtained from the test boring. The test-production well would be perforated in the zone in which the radial collector well laterals would be installed. Spinner logging will be performed on the test well following well development.
3. A network of four nested monitoring wells would be installed in the vicinity of the test-production well to monitor groundwater levels during aquifer testing using the test-production well. It is assumed that each nested monitoring well would consist of a water table monitoring zone and a well perforated in the radial collector well production zone. The nested monitoring wells would be installed at radial distances of approximately 25 feet, 75 feet, 150 feet and 300 feet from the test-production well. The purpose of the monitoring wells would be to provide stratigraphic information and groundwater level data during aquifer testing. The groundwater level data would be used to calculate estimates of the hydraulic conductivity of the planned radial collector well production zone and the overlying material through which Sacramento River water must pass.
4. Aquifer testing would be conducted in the test-production well. Step testing would be conducted over an approximately nine-hour period to estimate the optimal pumping rate for a constant rate test. The step test would be conducted by pumping the well in a series of steps in which the pumping rate would be incrementally increased at specified time intervals. Data collected during the step test would consist of pumping rate and drawdown measurements in the test-production well. A 72-hour constant rate test would be conducted in the test-production well after allowing groundwater levels

to recover. Data collected during the constant rate test would consist of pumping rate and drawdown measurements in the test-production well and drawdown measurements in the nested monitoring wells. The data would be used to calculate estimates of the radial hydraulic conductivity in the planned radial collector well production zone and vertical hydraulic conductivity in the overlying aquifer materials.

5. Groundwater samples would be collected from the test-production well during the constant rate test. The samples would be collected at 12-hour intervals beginning at the start of the test. The samples would be analyzed for general chemistry and metals to help assess changes in water quality with time during pumping, and stable isotopes of oxygen and hydrogen to assess the sources of water reaching the test-production well (groundwater vs. Sacramento River water). For comparative purposes, water samples from the Sacramento River would be collected and analyzed for the same set of parameters. Depth-discrete samples will be collected from the test well following the aquifer test to characterize changes in aquifer water quality throughout the screened interval. The sampling depth will be determined based on the results of spinner logging.
6. The stratigraphic information collected from the test borings, including monitoring well borings, and the aquifer hydraulic parameter information obtained from the aquifer testing would be used to develop a simple groundwater flow model to assess the radial collector well yield. The groundwater model would be constructed using the stratigraphy and aquifer hydraulic properties estimated from the field studies, but pumping would be simulated using the geometry and hydraulics of the radial collector well laterals. The simulation would support improved estimates of the radial collector well yield and water quality.

Upon completion of the detailed site-specific hydrogeologic and geochemical evaluations, an assessment of water quality and quantity, and quantification of infiltration capacity, it will be possible to determine whether radial collector wells are suitable for the Chico District. Information from these additional studies would also provide the data necessary to prepare a cost comparison between a conventional surface water intake and a radial collector well system, further evaluate treatment requirements, evaluate potential environmental impacts, and determine what environmental documentation, permits and approvals will be required.

WEST YOST ASSOCIATES
Consulting Engineers

TECHNICAL MEMORANDUM

DATE: December 21, 2012 Project No.: 436-00-12-17

TO: Michael Pembroke, Cal Water

CC: Peter Bonacich, Cal Water
Tom Salzano, Cal Water
Vickie Newlin, Butte County

FROM: Charles Duncan, R.C.E. #55498
Elizabeth Drayer, R.C.E. #46782
Amy Kwong, R.C.E. #73213

REVIEWED BY: Gerry Nakano, R.C.E. #29524

SUBJECT: Surface Water Supply Feasibility Study for Cal Water's Chico District – Phase 2 – Hydrogeologic Characterization and Recommendations for Site-Specific Field Studies for the Sacramento River Diversion

INTRODUCTION AND PURPOSE

The purpose of the Surface Water Supply Feasibility Study for the California Water Service Company's (Cal Water's) Chico District is to assess the feasibility of utilizing Butte County's State Water Project (SWP) long-term contract supply as a supplemental drinking water supply for Cal Water's Chico District service area.

In early 2012, West Yost Associates (West Yost) conducted a Phase 1 evaluation to evaluate the and reliability of Butte County's SWP supply and evaluate several potential conveyance alternatives for delivery of the surface water supply to the Chico District. West Yost's Phase 1 evaluation was documented in a technical memorandum dated April 26, 2012.

The Phase 1 evaluation identified the following two preferred alternatives for conveyance of surface water supplies to the Chico District:

- Diversion directly from the Thermalito Forebay with a transmission pipeline along the Abandoned Sacramento Northern Railroad to the Chico District; and
- Diversion from the Sacramento River using radial collector wells (requiring a surface water exchange between U.S. Bureau of Reclamation and DWR) with a transmission pipeline along Highway 32 to the Chico District.

Phase 2 of this Study includes additional analyses to further understand and refine these two preferred alternatives. An evaluation of the feasibility of a diversion and transmission pipeline from the Thermalito Forebay for Phase 2 is presented in a separate technical memorandum (TM). The purpose of this TM is to support the Phase 2 analyses by presenting a conceptual understanding of the hydrogeologic conditions in the vicinity of the proposed diversion point on the Sacramento River for the radial collector wells. In addition, based on an evaluation of the current hydrogeologic conditions, this TM also provides a preliminary hydrogeologic work plan to assess the feasibility, anticipated yield and proposed design of the radial collector wells for implementation in Phase 3 of this Study. Phase 3, expected to begin in 2013, will continue the evaluation of the two preferred alternatives to identify the final preferred alternative for potential design and construction.

The following sections provide an overview of the existing hydrogeologic setting in the vicinity of the proposed diversion on the Sacramento River and include a review of groundwater basin boundaries and hydrology, regional geology, and historical groundwater and surface water conditions. Key findings and conclusions from this evaluation are then developed into a preliminary hydrogeologic work plan.

OVERVIEW OF HYDROGEOLOGIC SETTING IN THE VICINITY OF PROPOSED DIVERSION

The location of the proposed diversion is shown on Figure 1. This location was selected due to its proximity to the Highway 32 corridor, which would be a suitable alignment for construction of a transmission pipeline to deliver raw (untreated) surface water to the Chico District for treatment and delivery. The following sections provide details on the existing hydrogeologic setting in the vicinity of the proposed diversion location.

Groundwater Basin Boundaries and Hydrology

As shown on Figure 2, the proposed diversion is located in the Vina groundwater subbasin (DWR Basin No. 5-21.57) within the Sacramento Valley groundwater basin (DWR Basin No. 5-21). The Vina subbasin is bounded by Deer Creek to the north, the Sacramento River to the west, Big Chico Creek to the south, and the foothills to the east.

DWR's Bulletin 118 (2004) provides the following summary of the Vina subbasin boundaries and hydrology:

- Overlies Tehama and Butte counties;
- Total surface area of 125,640 acres (195 square miles);
- Deer Creek and Big Chico Creek form hydrologic boundaries in the near surface;
- The eastern foothills (Chico Monocline) form a geographic boundary (however, a component of basin recharge is located east of the fault structure);
- Neighboring Los Molinos and West Butte subbasins are considered hydrologically contiguous at depth; and
- Annual precipitation within the subbasin ranges from 18 to 22.5 inches and increases to the east.

Groundwater from the Vina subbasin is used to meet the majority (over 95 percent) of the water demands within the subbasin, which is primarily agricultural demands.[1,2]

Butte County has an adopted Groundwater Management Plan (GMP) and the goal of this GMP is to maintain efficient and effective groundwater management, quantity and quality, thereby providing a sustainable, high quality supply for agricultural, environmental, and urban use into the future that remains protective of residents' health, welfare, and safety.[3] More specifically, the groundwater management objectives established by the GMP are the following:

- Minimize long-term drawdown of groundwater levels;
- Protect groundwater quality;
- Prevent inelastic land surface subsidence from occurring as a result of groundwater pumping;
- Minimize changes to surface water flows and quality that directly affect groundwater levels or quality;
- Minimize the effect of groundwater pumping on surface water flows and quality;
- Evaluate groundwater replenishment and cooperative management projects; and
- Provide effective and efficient management of groundwater recharge projects and areas.

Therefore, the development of potential radial collector wells will need to be consistent with the goals and objectives of Butte County's GMP.

Regional Geology

The principal hydrogeologic units within the Vina subbasin consist of continental deposits of Tertiary (*e.g.*, Tuscan formation) to late Quaternary (*e.g.*, Holocene stream channel and basin deposits and Modesto and Riverbank Formations) age. Table 1 provides a summary of the key characteristics of the freshwater-bearing formations in the Vina subbasin.

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[1] CDM, Butte County Water Inventory and Analysis, March 2001.

[2] DWR, Bulletin 118 Groundwater Basin Descriptions, updated February 27, 2004.

[3] CDM, Butte County Groundwater Management Plan, September 2004.

Table 1. Summary of Freshwater-Bearing Formations in the Vina Subbasin[a]

Deposit/ Formation	Typical Thickness, feet	Primary Materials	Source	Notes
Holocene Stream Channel Deposits	1 to 80	Unconsolidated Gravel, Sand, Silt, and Clay	Erosion, reworking, and deposition of adjacent Tuscan Formation and Quaternary stream terrace alluvial deposits	Represents the upper part of the unconfined zone and is moderately to highly permeable. However, its thickness and extent limit the water-bearing capability.
Holocene Basin Deposits	Up to 150	Silts and Clays	Spread by sediment-laden floodwaters that rose above the natural levees.	May be locally interbedded with stream channel deposits. Low permeability and generally yield low quantities of groundwater with poor quality.
Pleistocene Modesto Formation[b]	10 to 200	Poorly indurated gravel and cobbles with sand, silt, and clay	Reworking and deposition of the Tuscan and Riverbank Formations.	Makes up the majority of the alluvial plain deposits except where older Riverbank Formation deposits occur and in the Nord area where overlying basin deposits predominate. The thickness limits the water-bearing capability. Provides water to domestic and shallow irrigation wells as well as to deeper wells with multiple zones of perforations. Groundwater yields are moderate to low.
Pleistocene Riverbank Formation[b]	10 to 200	Poorly to highly permeable pebble and small cobble gravels interlensed with reddish clay, sands, and silt	Eroded from the surrounding mountain ranges.	Underlie the region between Pine and Rock Creeks. The thickness limits the water-bearing capability. Provides water to domestic and shallow irrigation wells as well as to deeper wells with multiple zones of perforations. Groundwater yields are moderate to high.
Pliocene Tuscan Formation[b]	Up to 1,250 A: 250 B: 600 C: 600	Volcanic mudflows, tuff breccia, tuffaceous sandstone, and volcanic ash layers.	Deposited as a series of volcanic lahars.	Consists of four separate but lithologically similar units. Units A, B and C are found in the Vina subbasin. Groundwater yields vary significantly depending on location.

[a] Source: DWR, Bulletin 118 Groundwater Basin Descriptions, updated February 27, 2004.
[b] Source: DWR, Butte County Groundwater Inventory Analysis, February 2005.

The Butte County Groundwater Inventory Analysis completed in February 2005 by DWR provides a compilation of a regional surface geologic map and subsurface geologic cross-sections. The regional geologic map including key subsurface geologic cross-sections are provided in Attachment A. A review of the subsurface geologic cross-sections (B-B' and E-E') within the vicinity of the proposed diversion location indicates that the freshwater-bearing formations consist of Holocene Stream Channel Deposits, Pleistocene Modesto Formation and the Pliocene Tuscan Formation.

Additional data from well completion reports were obtained from DWR and subsequently evaluated to further define the subsurface geology within the vicinity of the proposed diversion location. Figure 3 shows the approximate well locations where well completion reports were obtained from DWR. Well log borehole data from these locations were compared to identify geologic similarities between boreholes and develop conceptual geologic cross-sections shown on Figure 3. Figure 4 presents the subsurface geology of cross-section 1-1', and Figure 5 presents cross-section 2-2'. Based on the geologic data presented on Figures 4 and 5, the subsurface geology within the vicinity of the proposed diversion location generally consists of gravel deposits between 20 to 90 feet below ground surface. Gravel deposits below 90 feet are intermixed with occasional layers of clay.

These subsurface geologic findings from the well completion logs are similar to additional data obtained from a geotechnical investigation completed by Caltrans for the construction of the Sacramento River Bridge, which replaced the old Gianelli Bridge near Hamilton City (refer to Figure 3 for location). Caltrans explored subsurface conditions by drilling 15- to 65-foot deep rotary wash borings. These borings indicated that the flood plain deposits along the river bank consist of very soft organic silty clays and loose to compact silts and very fine to fine sands. Compact to very dense sandy gravels were encountered approximately 20 feet below the ground surface. The results from the geotechnical investigation for the Sacramento River Bridge are provided in Attachment B for reference.

Historical Groundwater Conditions

The following sections provide a general overview of the groundwater conditions in the vicinity of the proposed diversion location.

Water Levels

A long-term comparison of spring to spring groundwater levels indicates that areas in the Vina subbasin that are not influenced by municipal pumpage show a general groundwater level decline as a result of the 1976-77 and 1987-94 droughts, followed by a recovery of groundwater levels to pre-drought conditions in more recent years.[4]

DWR currently monitors groundwater levels at five wells located near the proposed diversion location as shown on Figure 6. Although most of these wells lie outside of the Vina subbasin boundary, they were considered relevant because of their proximity to the Vina subbasin and the proposed diversion location. Based on the data available in DWR's Water Data Library, three of the five wells that lie within the vicinity of the proposed diversion have a period of record of 10 years or less and were subsequently omitted from further analysis due to lack of long-term historical data. Therefore, only Wells 22N/02W-29K001M and 22N/01W-05M001M were reviewed in more detail.

[4] DWR, Bulletin 118 Groundwater Basin Descriptions, updated February 27, 2004.

The available historical spring groundwater level data for Well 22N/02W-29K001M shows that the average spring groundwater elevation is approximately 127 feet above mean sea level (ft msl). Figure 7 shows the historical spring groundwater level trend for Well 22N/02W-29K001M. As shown in this groundwater level hydrograph, the average spring to spring groundwater level rate of change for Well 22N/02W-29K001M is -0.05 ft/yr.

Review of the available historical spring groundwater level data for Well 22N/01W-05M001M shows that the average spring groundwater elevation is approximately 137 ft msl. Figure 8 shows the historical spring groundwater level trend for Well 22N/01W-05M001M. As shown in this groundwater level hydrograph, the average spring to spring groundwater level rate of change for Well 22N/01W-05M001M is +0.01 ft/yr

The historical spring groundwater levels and average spring to spring groundwater level rate of change discussed above appear to correlate well with the groundwater level evaluation presented in the 2008 Chico-Hamilton City District Water Supply and Facilities Master Plan (WSFMP). Based on an evaluation completed on the groundwater wells located in the Vina subbasin within the Chico District, the average rate of historical groundwater level rate of change reported in the WSFMP was -0.09 ft/yr. In addition, three groundwater wells located in Hamilton City also showed a stable trend for average spring to spring groundwater levels. Although these wells in Hamilton City are not in the Vina subbasin, they are located in close proximity of the proposed diversion point. Overall, the values obtained from the DWR monitoring wells discussed above and those reported in the WSFMP are indicative of relatively stable groundwater levels near and within the Vina subbasin.

The average groundwater elevation within the Vina subbasin ranges from 130 ft msl in the southwest to 200 ft msl in the northeast as shown on Figure 9, which is a groundwater elevation contour map developed by DWR for Spring 1997 groundwater levels. The proposed diversion location falls on the 130 ft msl groundwater level contour on the Spring 1997 groundwater elevation map. Figure 9 also indicates that the groundwater in the Vina subbasin generally flows in a southwesterly direction.

Water Quality

Based on information presented in DWR's Bulletin 118, the Vina subbasin is characterized by calcium-magnesium bicarbonate and magnesium-calcium bicarbonate as the predominant groundwater types in the subbasin. Total dissolved solids concentrations average 285 mg/L. Water quality impairments include localized high calcium, nitrates, and total dissolved solids in the Chico area.

In the WSFMP, a summary of potential water quality concerns was presented. It is important to note that the groundwater quality concerns characterize all the subbasins within the Chico-Hamilton City District and are not specific to the vicinity of the proposed diversion location. Some potential water quality concerns outlined in the WSFMP for the Vina subbasin include four regional groundwater contamination plumes and 13 active unauthorized chemical releases to groundwater. However, these contamination sites have been identified and are currently being regulated. Despite the identified contamination sites identified within the Vina subbasin, only five

out of a total of 60 wells located in Chico-Hamilton City District have been impacted by water quality concerns.

It should also be noted that water quality data for three wells located in Hamilton City were evaluated in the WSFMP. These wells are located just west of the proposed diversion point, but are not located within the Vina subbasin. Data reviewed for these wells indicated no constituents exceeded established Maximum Contaminant Levels (MCLs).

In 2006, the United States Geological Survey (USGS) completed a Groundwater Ambient Monitoring and Assessment (GAMA) study for the Middle Sacramento Valley study unit. The GAMA study summarized groundwater quality results from June through September 2006 for the following groundwater subbasins: Corning, Vina, Colusa, West Butte, East Butte, Sutter, North Yuba, and South Yuba. Of the wells sampled for the GAMA study, four wells were located in the vicinity of the proposed diversion location. These four wells were referred to as ESAC-04, ESAC-15, WSAC-07 and WSAC-35 in the GAMA study. Results of the GAMA study sampling for the wells in the vicinity of the proposed diversion location are summarized in Table 2. Locations of these wells relative to the proposed diversion location were shown previously on Figure 6. In summary, the results from these wells indicate that for the analyzed constituents from each well, none were detected above established thresholds.[5]

Historical Surface Water Conditions in the Sacramento River

Studies completed by USGS indicate that most of the water in the Sacramento River is derived from melting snow that enters the river by managed discharges of water from reservoirs.[6] In the vicinity of the proposed diversion location, the water flowing down the Sacramento River has been released from Shasta Dam, located approximately 110 river miles upstream. USGS notes that the Sacramento River has good water quality most of the year with low concentrations of dissolved minerals; however, seasonal events, such as agricultural and historical mining runoff may affect water quality. In addition, variable climatic conditions including rainfall, coupled with competing demands for water uses, affect the aquatic ecology of the Sacramento River.

The following sections provide a summary of the hydrologic and water quality data from the Sacramento River provided by DWR for Station #A0263000 (Sacramento River at Hamilton City). This station is located on the east side of the Sacramento River Bridge and is in very close proximity to the proposed diversion location.

[5] Schmitt, S.J., Fram, M.S., Milby Dawson, B.J., Belitz, K., 2008. Ground-water quality data in the middle Sacramento Valley study unit, 2006—results from the California GAMA program: U.S. Geological Survey Data Series 385.

[6] USGS, Water Quality in the Sacramento River Basin: U.S. Geological Survey Circular 1215, 2000.

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Table 2. Summary of GAMA Program Analysis Results for Wells near the Proposed Diversion Location							
Contaminant Category/ Specific Constituent	Laboratory Reporting Level, µg/L	Threshold Type[1]	Threshold Value, µg/L	ESAC-04, µg/L	ESAC-15, µg/L	WSAC-07, µg/L	WSAC-35, µg/L
Volatile Organic Compounds, Gasoline Oxygenates and Their Degradates							
Chloroform (Trichloromethane)	0.024	MCL-US	80[2]	NC	E0.06	NC	NC
Bromodichloromethane	0.028	MCL-US	80[2]	NC	ND	NC	NC
Bromoform	0.1	MCL-US	80[2]	NC	ND	NC	NC
Methyltertbutylether (MTBE)	0.1	MCL-CA	13	NC	ND	NC	NC
1,2,4-Trimethylbenzene	0.056	NL-CA	330	NC	ND	NC	NC
1,3,5-Trimethylbenzene	0.044	NL-CA	330	NC	ND	NC	NC
1,2,3-Trimethylbenzene	0.09	NA	NA	NC	ND	NC	NC
1,2,3,4-Tetramethylbenzene	0.14	NA	NA	NC	ND	NC	NC
1,2,3,5-Tetramethylbenzene	0.18	NA	NA	NC	ND	NC	NC
2-Ethyltoluene	0.06	NA	NA	NC	ND	NC	NC
4-Isopropyltoluene	0.08	NA	NA	NC	ND	NC	NC
Benzene	0.021	MCL-CA	1	NC	ND	NC	NC
m and p-Xylene	0.06	MCL-CA	1,750	NC	ND	NC	NC
Toluene	0.02	MCL-CA	150	NC	ND	NC	NC
Perchloroethene (PCE)	0.03	MCL-US	5	NC	0.51	NC	NC
1,1-Dichloroethane	0.035	MCL-CA	5	NC	0.11	NC	NC
cis-1,2-Dichloroethene	0.024	MCL-CA	6	NC	2.06	NC	NC
Carbontetrachloride	0.06	MCL-CA	0.5	NC	ND	NC	NC
trans-1,2-Dichloroethene	0.032	MCL-CA	10	NC	E0.01	NC	NC
Trichloroethene (TCE)	0.038	MCL-US	5	NC	0.11	NC	NC
Acetone	6	NA	NA	NC	ND	NC	NC
2-Butanone (MEK, Methylethylketone)	2	HAL-US	4,000	NC	ND	NC	NC
Carbon disulfide	0.038	NL-CA	160	NC	ND	NC	NC
Trichlorofluoromethane (CFC-11)	0.08	MCL-CA	150	NC	ND	NC	NC
Pesticides and/or Pesticide Degradates							
Bentazon	0.024	MCL-CA	18	NC	NC	ND	E0.005
Atrazine	0.008	MCL-CA	1	NC	NC	E0.005	E0.005
Simazine	0.005	MCL-US	4	NC	NC	E0.005	E0.004
Metolachlor	0.006	HAL-US	700	NC	NC	ND	ND
Hexazinone	0.026	HAL-US	400	NC	NC	ND	E0.016
Dinoseb	0.038	MCL-US	7	NC	NC	ND	ND
Molinate	0.003	MCL-CA	20	NC	NC	ND	ND
Prometon	0.01	HAL-US	100	NC	NC	ND	ND
Acetochlor	0.006	NA	NA	NC	NC	ND	ND
Metribuzin	0.028	HAL-US	70	NC	NC	ND	ND
Tebuthiuron	0.026	HAL-US	500	NC	NC	ND	ND
Propanil	0.011	NA	NA	NC	NC	ND	ND
Bensulfuronmethyl	0.018	NA	NA	NC	NC	ND	ND
MCPA	0.07	HAL-US	30	NC	NC	ND	ND
Triclopyr	0.026	NA	NA	NC	NC	ND	ND
2,4-D	0.038	MCL-US	70	NC	NC	ND	ND
Chlorimuron	0.032	NA	NA	NC	NC	ND	ND
Bromacil	.01	HAL-US	70	NC	NC	V0.004	ND
Chlorpyrifos	0.005	HAL-US	2	NC	NC	ND	ND
Carbaryl	0.041	RSD5-US	400	NC	NC	ND	ND
Fipronil	0.016	NA	NA	NC	NC	ND	ND
cis-Propiconazole	0.013	NA	NA	NC	NC	ND	ND
trans-Propiconazole	0.034	NA	NA	NC	NC	ND	ND
Deethylatrazine	0.028	NA	NA	NC	NC	E0.006	E0.006
3,4-Dichloroaniline	0.0045	NA	NA	NC	NC	ND	E0.006
Hydroxyatrazine	0.032	NA	NA	NC	NC	ND	ND
Desulfinylfipronil	0.012	NA	NA	NC	NC	ND	ND
Fipronilsulfide	0.013	NA	NA	NC	NC	ND	ND
Fipronilsulfone	0.024	NA	NA	NC	NC	ND	ND
Deisopropylatrazine	0.08	NA	NA	NC	NC	ND	ND
Nutrients and Dissolved Organic Carbon							
Ammonia (as nitrogen)	0.01	HAL-US	24.7 (mg/L)[3]	NC	E0.008	NC	ND
Nitrate plus nitrite (as nitrogen)	0.06	MCL-US	10 (mg/L)	NC	ND	NC	0.97
Nitrite (as nitrogen)	0.002	MCL-US	1 (mg/L)	NC	ND	NC	ND
Total nitrogen (ammonia + nitrate + nitrite + organic nitrogen as nitrogen)	0.06	NA	NA	NC	ND[3]	NC	1.04
Orthophosphate (as phosphorus)	0.006	NA	NA	NC	V0.003	NC	0.036
Dissolved organic carbon (DOC)	0.33	NA	NA	NC	NC	NC	NC
Major and Minor Ions and Total Dissolved Solids							
Bicarbonate[4]	1	NA	NA	NC	143	NC	250
Carbonate[4]	1	NA	NA	NC	ND	NC	ND
Bromide	0.02	NA	NA	NC	0.03	NC	0.02
Calcium	0.02	NA	NA	NC	22.4	NC	45.2
Chloride	0.2	SMCL-CA	250 (500) (mg/L)[5]	NC	8.13	NC	16.9
Fluoride	0.1	MCL-CA	2	NC	E0.07	NC	E0.07
Iodide	0.002	NA	NA	NC	ND	NC	0.003
Magnesium	0.008	NA	NA	NC	14.4	NC	18.9
Potassium	0.16	NA	NA	NC	1.17	NC	0.86
Silica	0.04	NA	NA	NC	60	NC	22.9
Sodium	0.2	NA	NA	NC	11.9	NC	23.6
Sulfate	0.18	SMCL-CA	250 (500) (mg/L)[5]	NC	6.3	NC	19.9
Total dissolved solids (TDS)	10	SMCL-US	500 (1,000) (mg/L)[5]	NC	195	NC	277

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Contaminant Category/ Specific Constituent	Laboratory Reporting Level, µg/L	Threshold Type[1]	Threshold Value, µg/L	ESAC-04, µg/L	ESAC-15, µg/L	WSAC-07, µg/L	WSAC-35, µg/L
Trace Elements							
Aluminum	1.6	MCL-CA	1,000	NC	E0.8	NC	E1.1
Antimony	0.2	MCL-US	6	NC	ND	NC	ND
Arsenic	0.12	MCL-US	10	NC	0.47	NC	1.2
Barium	0.2	MCL-CA	1,000	NC	16	NC	142
Beryllium	0.06	MCL-US	4	NC	NC	NC	NC
Boron	8	NL-CA	1,000	NC	83	NC	128
Cadmium	0.04	MCL-US	5	NC	ND	NC	ND
Chromium	0.4	MCL-CA	50	NC	6.7	NC	2.2
Cobalt	0.04	NA	NA	NC	ND	NC	ND
Copper	0.4	AL-US	1,300	NC	E0.21	NC	0.66
Iron	6	SMCL-CA	300	NC	ND	NC	ND
Lead	0.08	AL-US	15	NC	0.14	NC	0.17
Lithium	0.6	NA	NA	NC	ND	NC	5.5
Manganese	0.2	SMCL-CA	50	NC	ND	NC	ND
Mercury	0.01	MCL-US	2	NC	NC	NC	NC
Molybdenum	0.4	HAL-US	40	NC	ND	NC	0.8
Nickel	0.06	MCL-CA	100	NC	V0.07	NC	0.11
Selenium	0.8	MCL-US	50	NC	0.16	NC	0.17
Silver	0.2	SMCL-CA	100	NC	NC	NC	NC
Strontium	0.4	HAL-US	4,000	NC	145	NC	619
Thallium	0.04	MCL-US	2	NC	ND	NC	ND
Tungsten	0.06	NA	NA	NC	ND	NC	ND
Vanadium	0.1	NL-CA	50	NC	17.7	NC	3.8
Zinc	0.6	SMCL-US	5,000	NC	V0.73	NC	3.3
Uranium	0.04	MCL-US	30	NC	0.08	NC	0.46
Inorganic Arsenic, Iron, and Chromium							
Iron (Total)	2	SMCL-CA	300	NC	ND	NC	ND
Iron (II)	2	NA	NA	NC	ND	NC	ND
Inorganic Arsenic (Total)	0.5	MCL-US	10	NC	V0.7	NC	V3.5
Inorganic Arsenic (III)	1	NA	NA	NC	ND	NC	ND
Chromium (Total)	1	MCL-CA	50	NC	2	NC	1
Chromium (VI)	1	NA	NA	NC	ND	NC	1
Isotope Ratios of Water and Tritum, Nitrogen and Oxygen Isotpoes in Nitrate							
δ^{2}H of water		NA	NA	-59.8	-67.0	-66.9	-68.8
δ^{18}O of water		NA	NA	-8.19	-9.73	-9.24	-9.37
Tritium		MCL-CA	20,000	2.8	1	13.4	7.4
δ^{15}N of nitrate		NA	NA	NC	ND	NC	2.63
δ^{18}O of nitrate		NA	NA	NC	ND	NC	7.86
δ^{13}O of dissolved carbonates		NA	NA	NC	-16.57	NC	-14.93
Carbon-14		NA	NA	NC	25	NC	94

Table 2. Summary of GAMA Program Analysis Results for Wells near the Proposed Diversion Location

1. Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists.

2. The MCL-US threshold for trihalomethanes is for the sum of chloroform, bromoform, bromodichloromethane, and dibromochloromethane.

3. Total nitrogen in these samples is less than the sum of the filtered nitrogen analytes and exceeds the USGS's National Water Quality Laboratory acceptance criteria of a 10 percent relative difference, but the sum of the filtered nitrogen analytes is less than the LRL for total nitrogen.

4. Bicarbonate and carbonate concentrations were calculated from the laboratory alkalinity and pH values using the advanced speciation method (http://or.water.usgs.gov/alk/methods.html) with pK1 = 6.35, pK2 = 10.33 and pKW = 14.

5. The recommended SMCL-CA thresholds for chloride, sulfate and total dissolved solids are listed with the upper SMCL-CA thresholds in parentheses.

Abbreviations:

AL U.S. Environmental Protection Agency Action Level

CDPH California Department of Public Health

E Estimated Value

HAL Lifetime Health Advisory Level (USEPA)

LRL Laboratory Reporting Level

MCL-US Maximum Contaminant Level (USEPA)

MCL-CA Maximum Contaminant Level (CDPH)

NA Not Available

ND Analyzed but not detected

NC Not Collected

NL-CA Notification Level (CDPH)

RSD5-US USEPA risk specific dose at a risk factor of 10^{-5} µg/L

SMCL-CA Secondary Maximum Contaminant Level (CDPH)

USEPA United States Environmental Protection Agency

V Analyte is detected in sample and an associated blank, thus data is not in groundwater quality analysis

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Flow and Stage Elevation

Figure 10 graphically presents the historical daily mean flow since April 21, 1945 and indicates that the minimum, average, and maximum historical daily mean flows are 2,700, 12,600, and 151,000 cubic feet per second (cfs), respectively. Figure 11 shows the historical daily mean stage elevation since October 1, 1975 and indicates that the minimum, average, and maximum stage elevations are 127, 131, and 150 ft msl, respectively. Flood stage at this DWR monitoring location is set at 148 ft msl. Based on the elevation of the gage datum, the Sacramento River has an average depth of approximately 30 feet near the proposed diversion location.

The greatest fluctuations in flow and stage elevation occur due to seasonal changes with peaks in the winter months (January to March) and lows in the late summer and fall months (August to November).

Water Quality

Figure 12 shows the average monthly water temperature pattern based on data collected between August 6, 2008 and December 23, 2011 and indicates that water temperatures gradually increase during the spring months to a maximum water temperature of about 63 degrees Fahrenheit during the summer. Low water temperatures occur in the winter month of January at an average of 48 degrees Fahrenheit.

Table 3 summarizes the historical range of available water quality data for constituents collected and analyzed between August 8, 2000 and August 7, 2012; constituents with results below the laboratory reporting limit have been omitted. Omitted constituents included contaminants such as MTBE and PCE where the laboratory results were below the reporting limit.

Figure 13 presents the historical data available for Total Dissolved Solids (TDS) and indicates that the TDS concentration is generally higher in the winter time (corresponding with increased surface runoff from winter storms) and lower in the summer time.

Table 3. Historical Range of Available Water Quality Data for Constituents Detected Above Reporting Limits[a,b]

Constituent	Minimum[b]	Maximum	Unit
Conductance (EC)	95	174	µS/cm
Dissolved Aluminum	0.83	914	µg/L
Dissolved Ammonia	< R.L.	0.04	mg/L as N
Dissolved Arsenic	0.859	2.49	µg/L
Dissolved Boron	< R.L.	0.1	mg/L
Dissolved Cadmium	< R.L.	0.021	µg/L
Dissolved Calcium	9	16	mg/L
Dissolved Chloride	2	6	mg/L
Dissolved Chromium	0.3	4.99	µg/L
Dissolved Copper	0.56	4.26	µg/L
Dissolved Hardness	39	73	mg/L as $CaCO_3$
Dissolved Iron	< R.L.	94.1	µg/L
Dissolved Lead	< R.L.	0.648	µg/L
Dissolved Magnesium	4	8	mg/L
Dissolved Manganese	0.08	9.75	µg/L
Dissolved Nickel	0.57	4.69	µg/L
Dissolved Nitrate	0.4	0.7	mg/L
Dissolved Nitrate + Nitrite	< R.L.	2.22	mg/L as N
Dissolved Organic Carbon	< R.L.	4.1	mg/L as C
Dissolved Organic Nitrogen	0.1	0.3	mg/L as N
Dissolved Ortho-phosphate	< R.L.	0.06	mg/L as P
Dissolved Potassium	0.8	3.8	mg/L
Dissolved Selenium	< R.L.	0.3	µg/L
Dissolved Silver	< R.L.	0.018	µg/L
Dissolved Sodium	4	10	mg/L
Dissolved Sulfate	3	12	mg/L
Dissolved Zinc	0.16	5.79	µg/L
Hardness	43	70	mg/L as $CaCO_3$
Ortho-phosphate	< R.L.	0.03	mg/L as P
pH	6.2	8.4	pH Units
Total Alkalinity	38	70	mg/L as $CaCO_3$
Total Aluminum	10.5	98.8	µg/L
Total Arsenic	1.15	4.07	µg/L
Total Cadmium	< R.L.	0.092	µg/L
Total Calcium	9	15	mg/L
Total Chromium	0.41	9.74	µg/L
Total Copper	0.73	8.21	µg/L
Total Dissolved Solids	51	112	mg/L
Total Hardness	55	61	mg/L as $CaCO_3$
Total Iron	7.8	10,052	µg/L
Total Lead	< R.L.	3.24	µg/L
Total Magnesium	5	8	mg/L
Total Manganese	1.61	9.58	µg/L
Total Mercury	0.28	2.8	ng/L
Total Nickel	0.59	8.02	µg/L
Total Organic Carbon	< R.L.	6.6	mg/L as C
Total Phosphorus	< R.L.	0.19	mg/L
Total Selenium	< R.L.	0.35	µg/L
Total Silver	< R.L.	2.11	µg/L
Total Suspended Solids	< R.L.	95	mg/L
Total Zinc	< R.L.	8.39	µg/L

[a] Source: DWR Water Data Library.
[b] R.L. = Reporting Limit

KEY FINDINGS AND CONCLUSIONS

The findings of this evaluation are summarized as follows:

- The proposed diversion location lies within the Vina subbasin of the Sacramento Valley groundwater basin;
- Butte County has an adopted Groundwater Management Plan with a primary goal to maintain efficient and effective groundwater management, and quantity and quality;
- The subsurface geology within the vicinity of the proposed diversion location generally consists of gravel deposits between 20 to 90 feet below ground surface; Gravel deposits below 90 feet are intermixed with occasional layers of clay;
- Groundwater levels appear to be stable in the Vina subbasin and at the proposed diversion point location;
- Groundwater in the Vina subbasin generally flows in a southwesterly direction;
- There appear to be no major groundwater quality impairments in the vicinity of the proposed diversion;
- Near the proposed diversion location, the minimum, average, and maximum historical daily mean flows in the Sacramento River are 2,700, 12,600, and 151,000 cfs, respectively; the minimum, average, and maximum stage elevations are 127, 131, and 150 ft msl, respectively; The Sacramento River has an average depth of approximately 30 feet near the proposed diversion location; and
- The Sacramento River has good water quality most of the year with low concentrations of dissolved minerals; total dissolved solids are generally higher in the winter time (corresponding with increased surface runoff from winter storms) and lower in the summer time.

Based on this conceptual evaluation of hydrogeologic conditions in the vicinity of the proposed diversion location, there does not appear to be any adverse hydrogeologic conditions that would impact the feasibility of the construction or operation of radial collector wells at the proposed diversion location. However, a site-specific field study will be required to evaluate the specific conditions at the proposed diversion location. A preliminary work plan for such a study is provided below.

PRELIMINARY HYDROGEOLOGIC WORK PLAN FOR PHASE 3

If the Chico District wishes to further pursue the diversion alternative from the Sacramento River using radial collector wells, the next logical step would be to perform site-specific field studies at the proposed point of diversion. These studies are necessary to gain additional understanding of the site-specific hydrogeologic conditions, probable well yield and water quality from the proposed radial collector wells at the proposed diversion location. The primary goals of these field studies would be to identify the stratigraphic sequence that would be penetrated by radial collector wells, and estimate the hydraulic conductivity of the major units in this stratigraphic sequence, the yield of a future radial collector well and expected water quality. It is anticipated that field studies would include the following components.

1. A test boring would be drilled to an approximate depth of 100 feet as close as possible to the site of the proposed radial collector wells. Samples would be collected from the drill cuttings at ten-foot intervals and at significant changes in sediment type. These samples would be logged by an experienced hydrogeologist using the Unified Soil Classification System Visual-Manual Procedure, and selected samples would be analyzed for grain size distribution by sieve testing. The test boring would be logged by a qualified geophysical contractor using short- and long-normal resistivity, single point resistivity and spontaneous-potential logging tools. This task would result in information on the stratigraphic sequence and the distribution of relative permeability with depth in the vicinity of the proposed radial collector wells.
2. A test-production well would be constructed in the test boring. The well would be designed based on the lithologic and geophysical logs and sieve test results obtained from the test boring. The test-production well would be perforated in the zone in which the radial collector well laterals would be installed. Spinner logging will be performed on the test well following well development.
3. Nested monitoring wells would be installed in the vicinity of the test-production well to monitor groundwater levels in specific aquifer zones during aquifer testing using the test-production well. The purpose of the monitoring wells would be to provide stratigraphic information and groundwater level data during aquifer testing. The groundwater level data would be used to calculate estimates of the hydraulic conductivity of the planned radial collector well production zone and the overlying material through which Sacramento River water must pass.
4. Aquifer testing would be conducted in the test-production well. Step testing would be conducted over an approximately nine-hour period to estimate the optimal pumping rate for a constant rate test. The step test would be conducted by pumping the well in a series of steps in which the pumping rate would be incrementally increased at specified time intervals. Data collected during the step test would consist of pumping rate and drawdown measurements in the test-production well. A 72-hour constant rate test would be conducted in the test-production well after allowing groundwater levels to recover. Data collected during the constant rate test would consist of pumping rate and drawdown measurements in the test-production well and drawdown measurements in the nested monitoring wells. Full water level recovery data would also be obtained. The data would be used to calculate estimates of the radial hydraulic conductivity in

the planned radial collector well production zone and vertical hydraulic conductivity in the overlying aquifer materials.

5. Groundwater samples would be collected from the test-production well during the constant rate test. The samples would be collected at 12-hour intervals beginning at the start of the test. The samples would be analyzed for general chemistry and metals to help assess changes in water quality with time during pumping, and stable isotopes of oxygen and hydrogen to assess the sources of water reaching the test-production well (groundwater vs. Sacramento River water). For comparative purposes, water samples from the Sacramento River would be collected and analyzed for the same set of parameters. Depth-discrete samples will be collected from the test well following the aquifer test to characterize changes in aquifer water quality throughout the screened interval. The sampling depth will be determined based on the results of spinner logging.
6. The stratigraphic information collected from the test borings, including monitoring well borings, and the aquifer hydraulic parameter information obtained from the aquifer testing would be used to develop a simple groundwater flow model to assess the radial collector well yield. The groundwater model would be constructed using the stratigraphy and aquifer hydraulic properties estimated from the field studies, but pumping would be simulated using the geometry and hydraulics of the radial collector well laterals. The simulation would support improved estimates of the radial collector well yield and water quality.

Upon completion of the detailed site-specific hydrogeologic and geochemical evaluations, an assessment of water quality and quantity, and quantification of infiltration capacity, it will be possible to determine whether radial collector wells are suitable for the Chico District. Information from these additional studies would also provide the data necessary to prepare a refined cost comparison between a conventional surface water intake and a radial collector well system, further evaluate treatment requirements, evaluate potential environmental impacts, and determine what environmental documentation, permits and approvals will be required.

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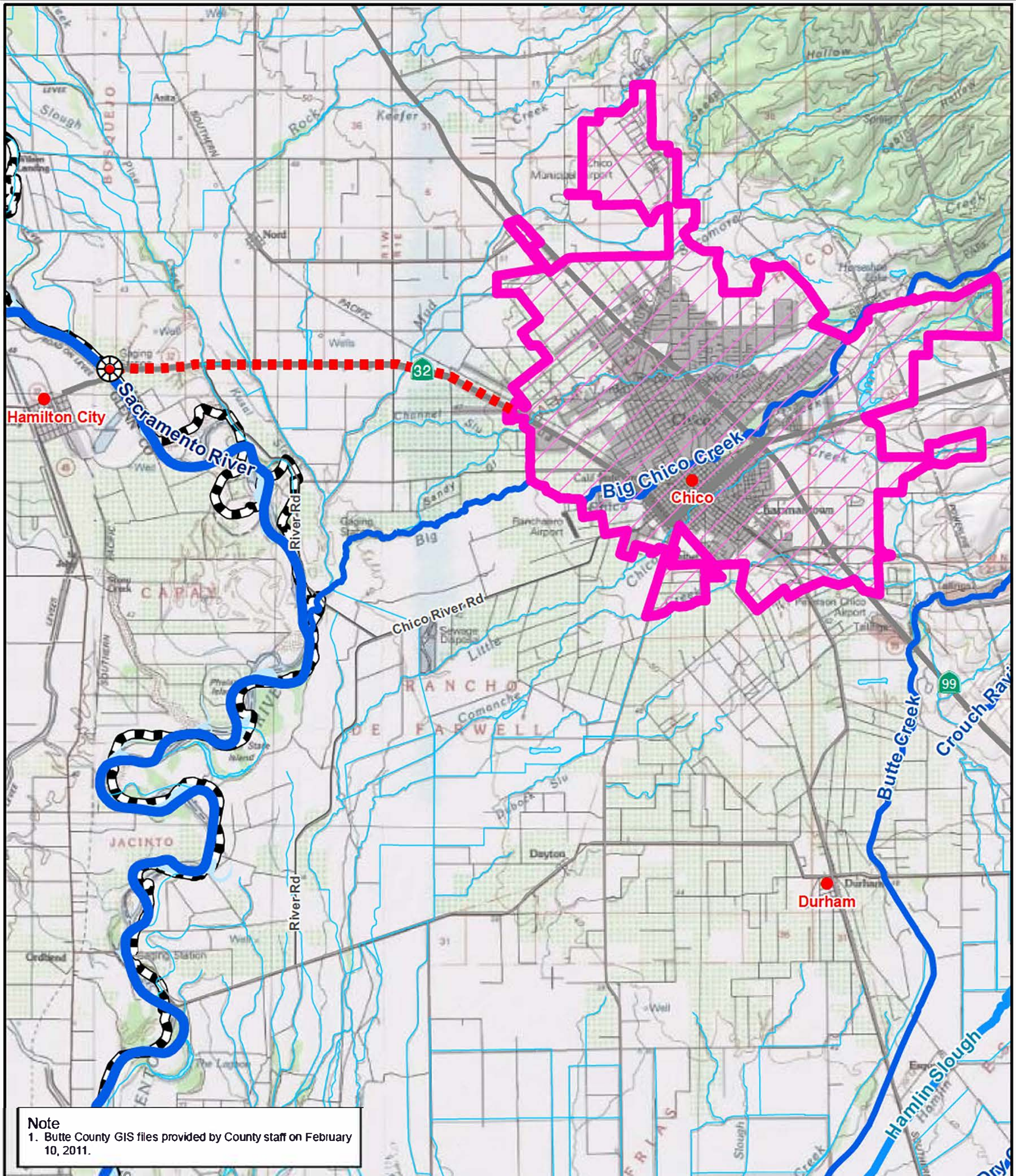

Note
1. Butte County GIS files provided by County staff on February 10, 2011.

LEGEND

Proposed Diversion Location

Proposed Transmission Main

Cal Water Chico District

Butte County

Water Feature

Water Body

N

0 1 2

Scale in Miles

FIGURE 1

California Water Service Company

Surface Water Supply Feasibility Study

PROPOSED DIVERSION LOCATION

CALIFORNIA WATER SERVICE CO.

WEST YOST ASSOCIATES

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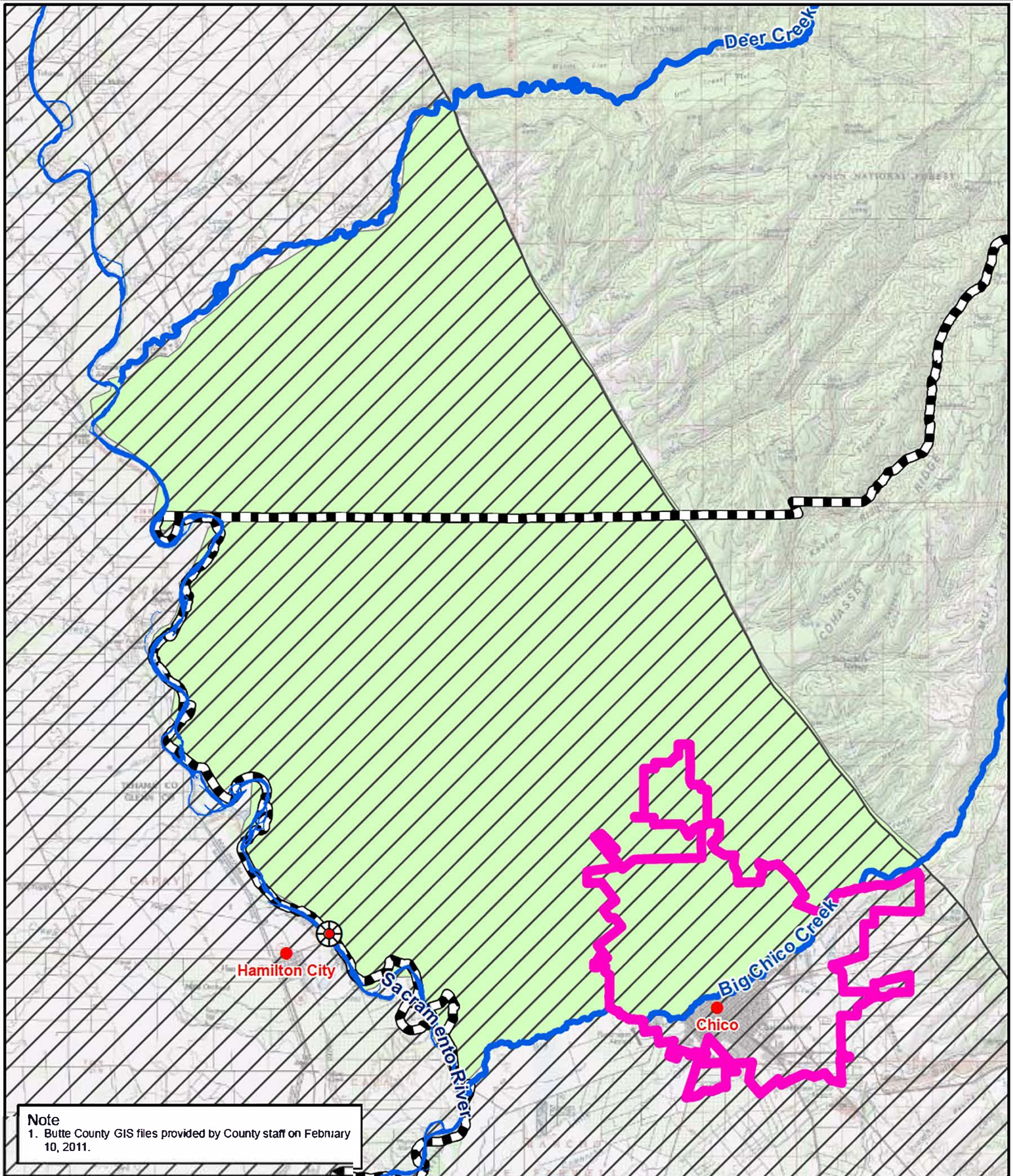

Note
1. Butte County GIS files provided by County staff on February 10, 2011.

LEGEND

- Proposed Diversion Location
- Vina Groundwater Subbasin
- Sacramento Valley Groundwater Basin
- Cal Water Chico District
- Butte County

N

0 1.5 3

Scale in Miles

FIGURE 2

California Water Service Company

Surface Water Supply Feasibility Study

GROUNDWATER BASIN BOUNDARIES AND HYDROLOGY

CALIFORNIA WATER SERVICE CO.

WEST YOST ASSOCIATES

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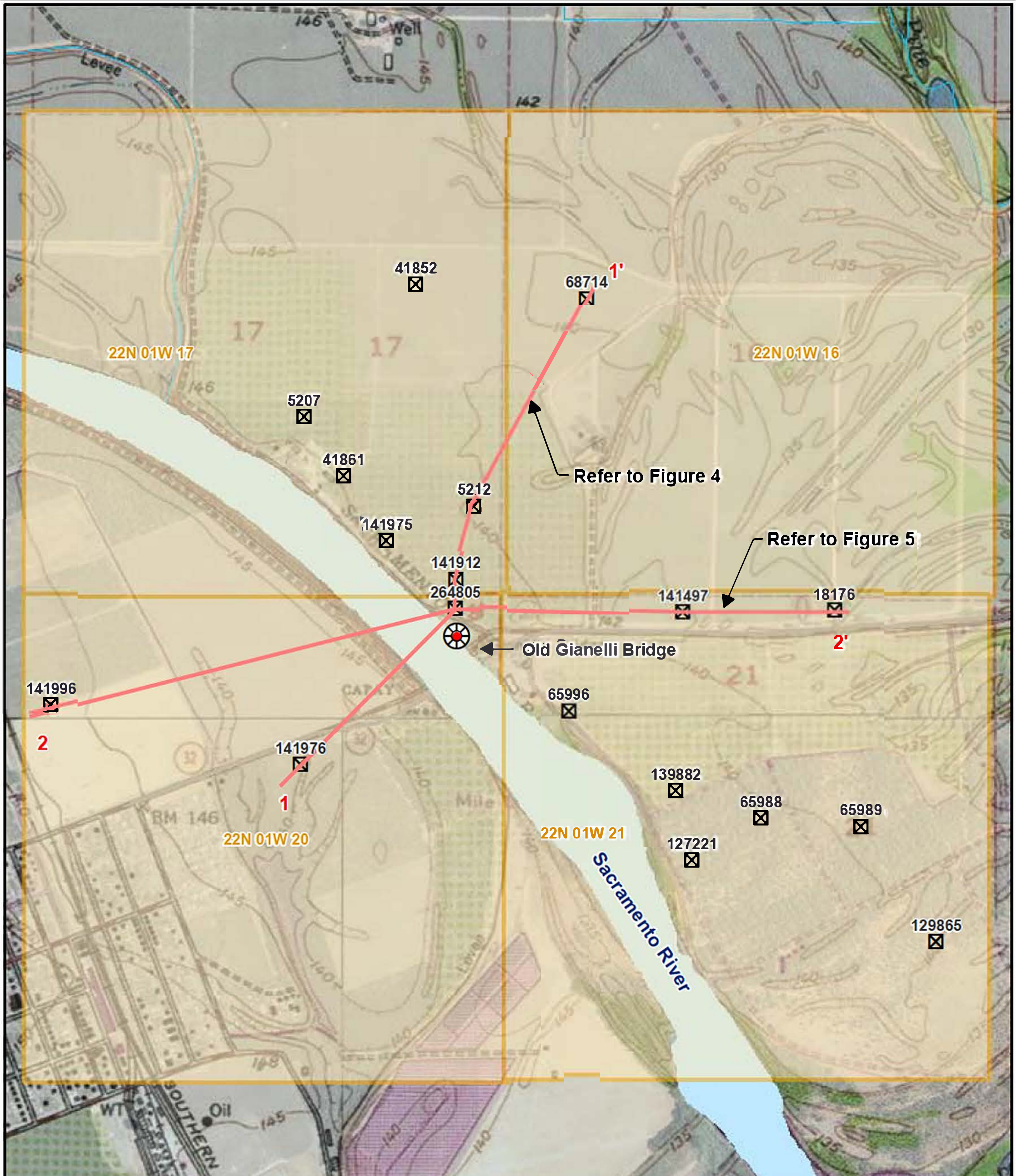

LEGEND

- Public Land Survey System Section
- Approximate Well Location based on Well Completion Report
- Proposed Diversion Location
- Cross Section

N

0 750 1,500

Scale in Feet

FIGURE 3

California Water Service Company

Surface Water Supply Feasibility Study

WELL COMPLETION REPORTS FROM DWR

WEST YOST ASSOCIATES

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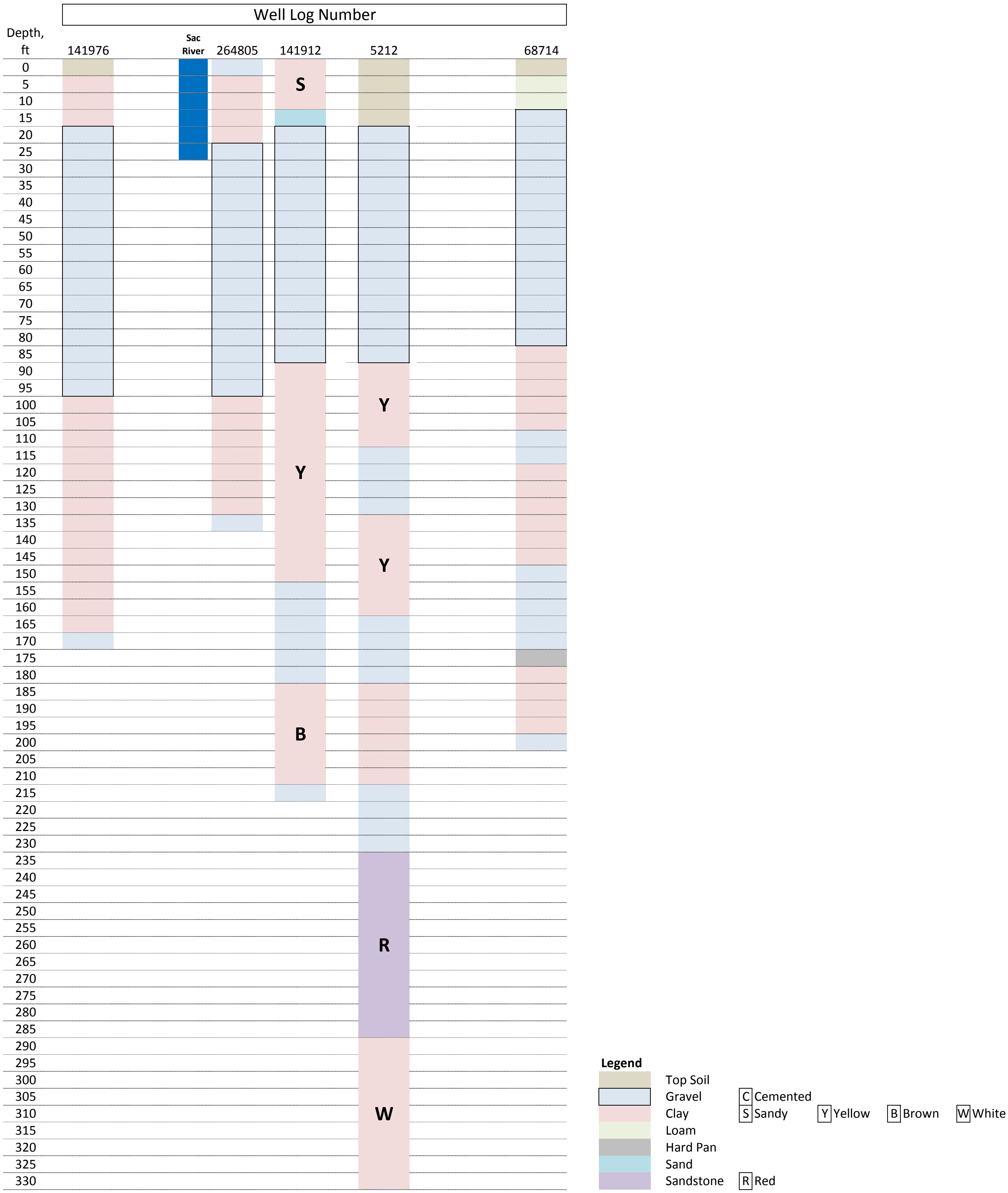
Figure 4. Subsurface Geology (Cross Section 1-1')[a]



[a] Refer to Figure 3 for location of cross section.

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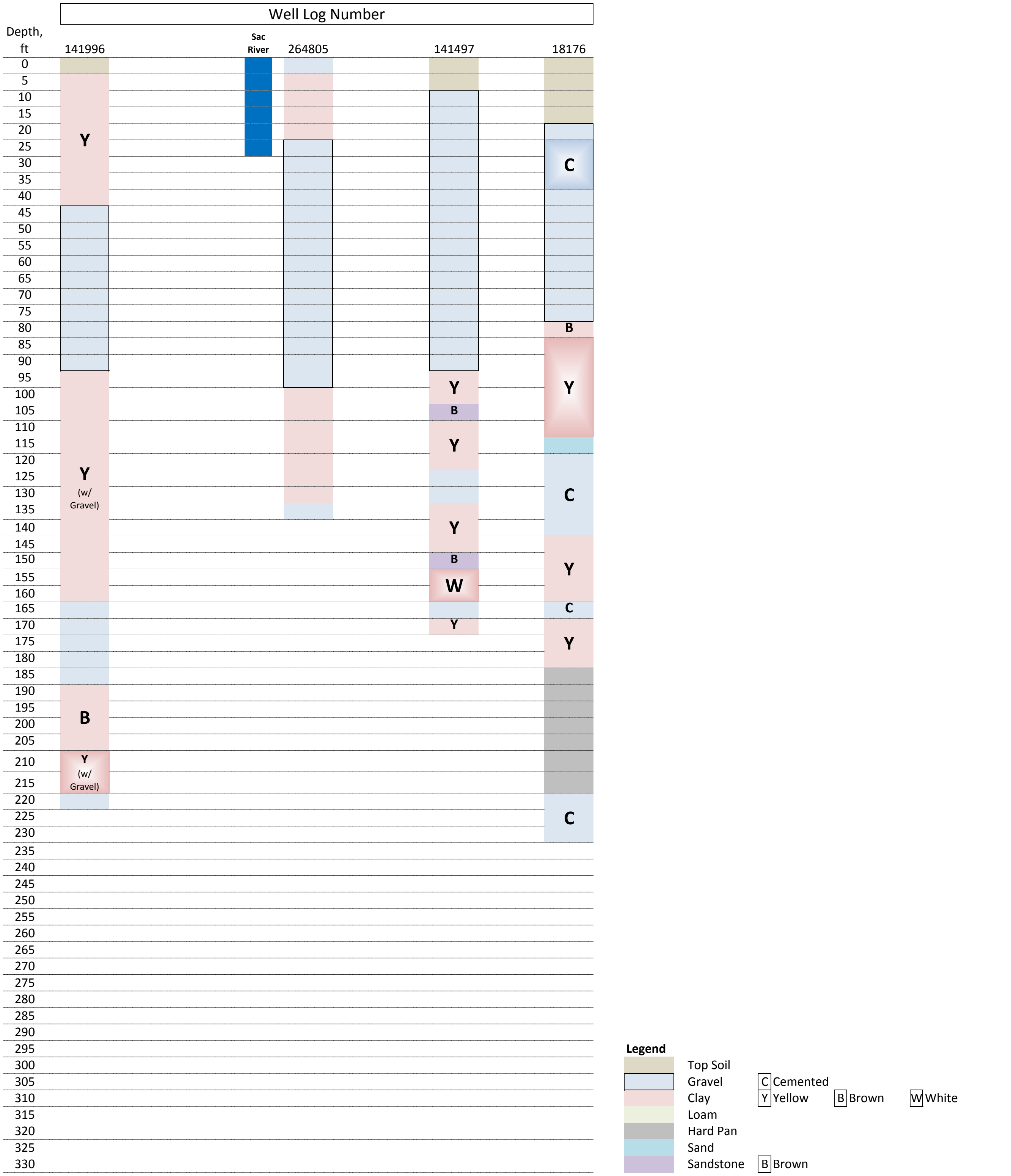
Figure 5. Subsurface Geology (Cross Section 2-2')[(a)]



[(a)] Refer to Figure 3 for location of cross section.

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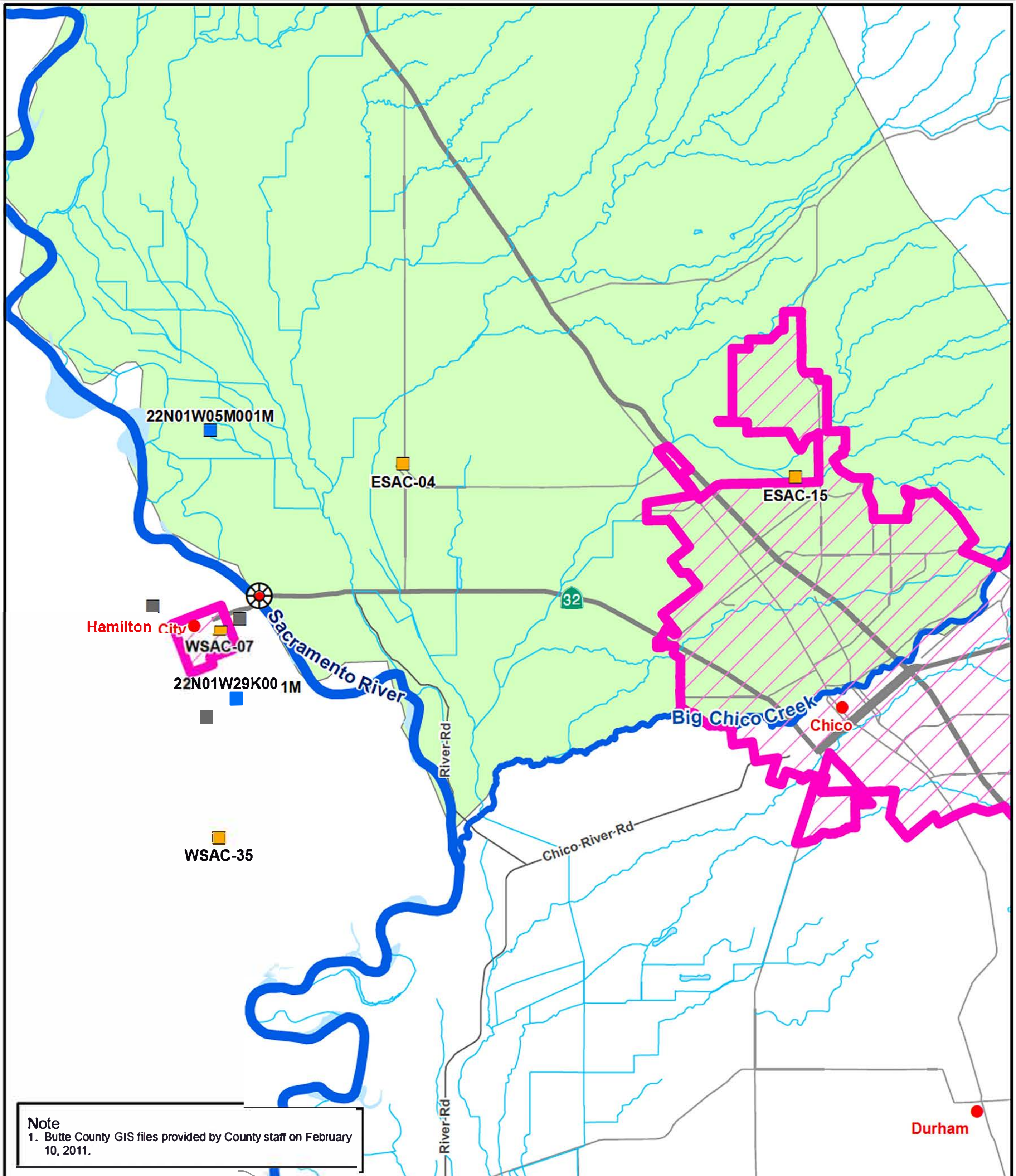

LEGEND

- DWR Well - Included in Analysis
- DWR Well - Not included in Analysis
- USGS GAMA Study Well
- Proposed Diversion Location
- Vina Subbasin
- Water Feature
- Water Body

N

0 1 2

Scale in Miles

FIGURE 6

California Water Service Company

Surface Water Supply Feasibility Study

LOCATIONS OF KEY MONITORING WELLS

CALIFORNIA WATER SERVICE CO.

WEST YOST ASSOCIATES

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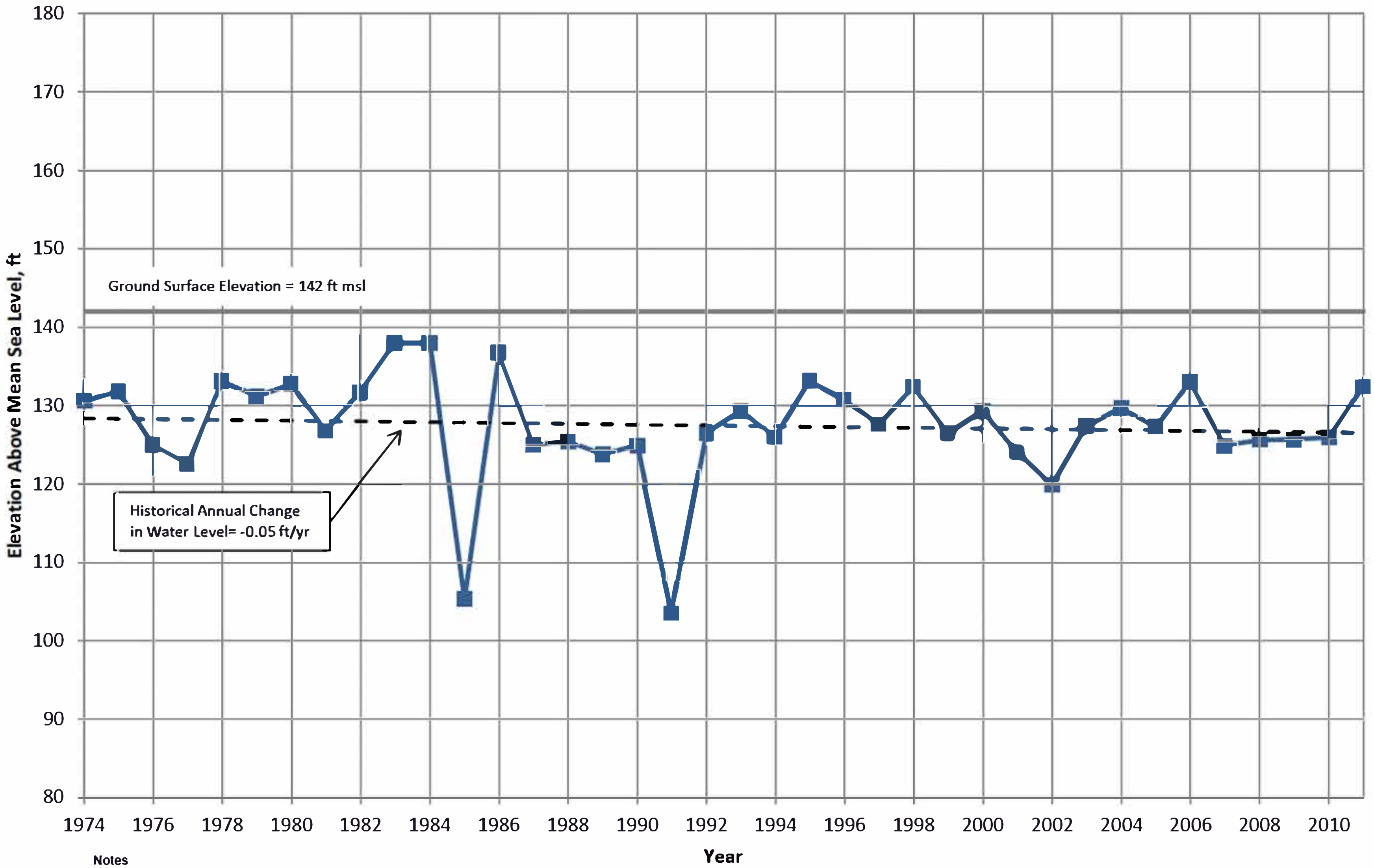
Figure 7. Spring Groundwater Level Hydrograph of Well 22N/01W-29K001M



Notes
1. Spring water level was determined to be the higestwater level recorded in either February, March or April.
2. Period of Record: 38 years.
3. Source: DWR Water Data Library.

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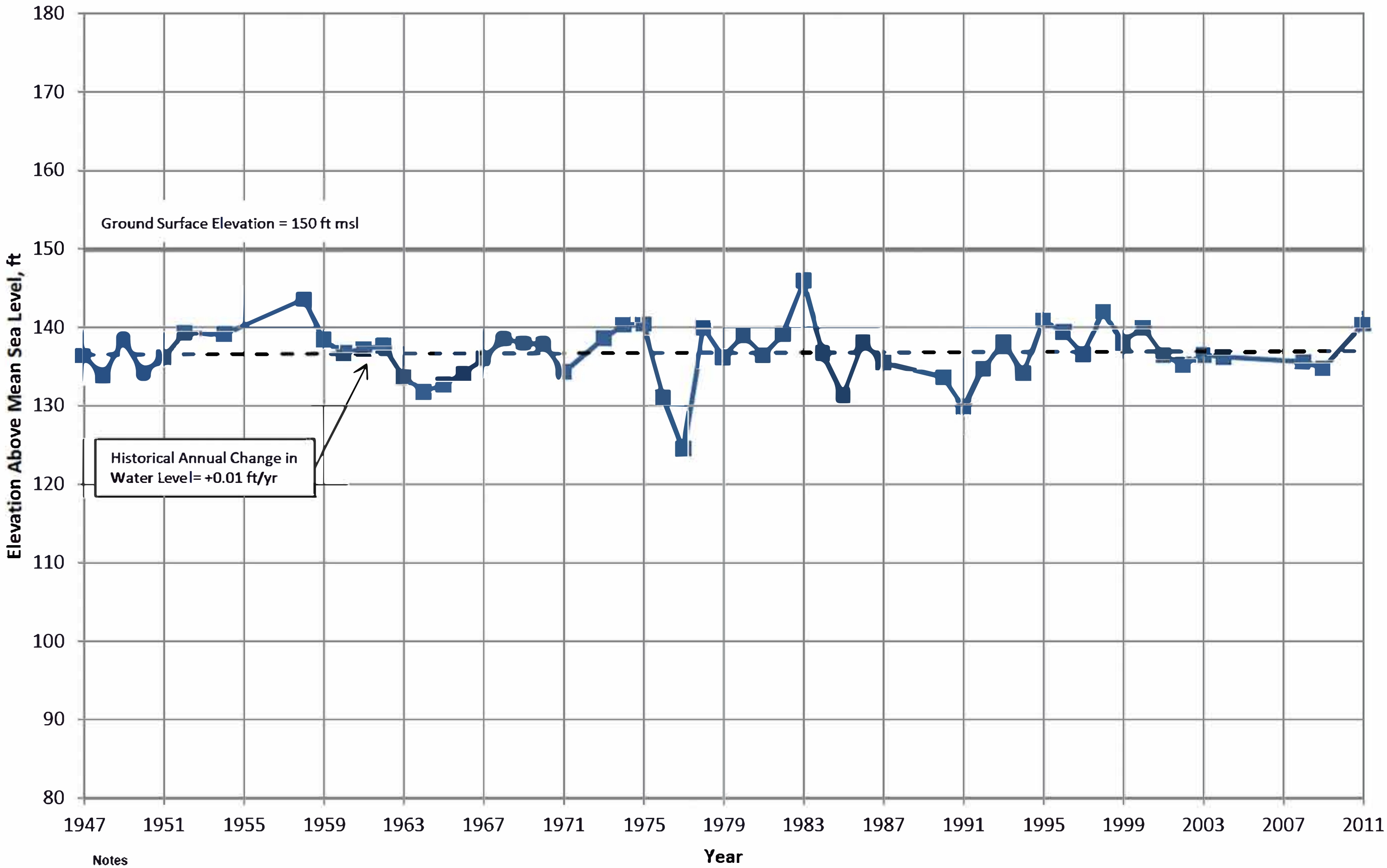
Figure 8. Spring Groundwater Level Hydrograph of Well 22N/01W-05M001M



Notes
1. Spring water level was determined to be the higest water level recorded in either February, March or April.
2. Period of Record: 64 years.
3. Source: DWR Water Data Library.

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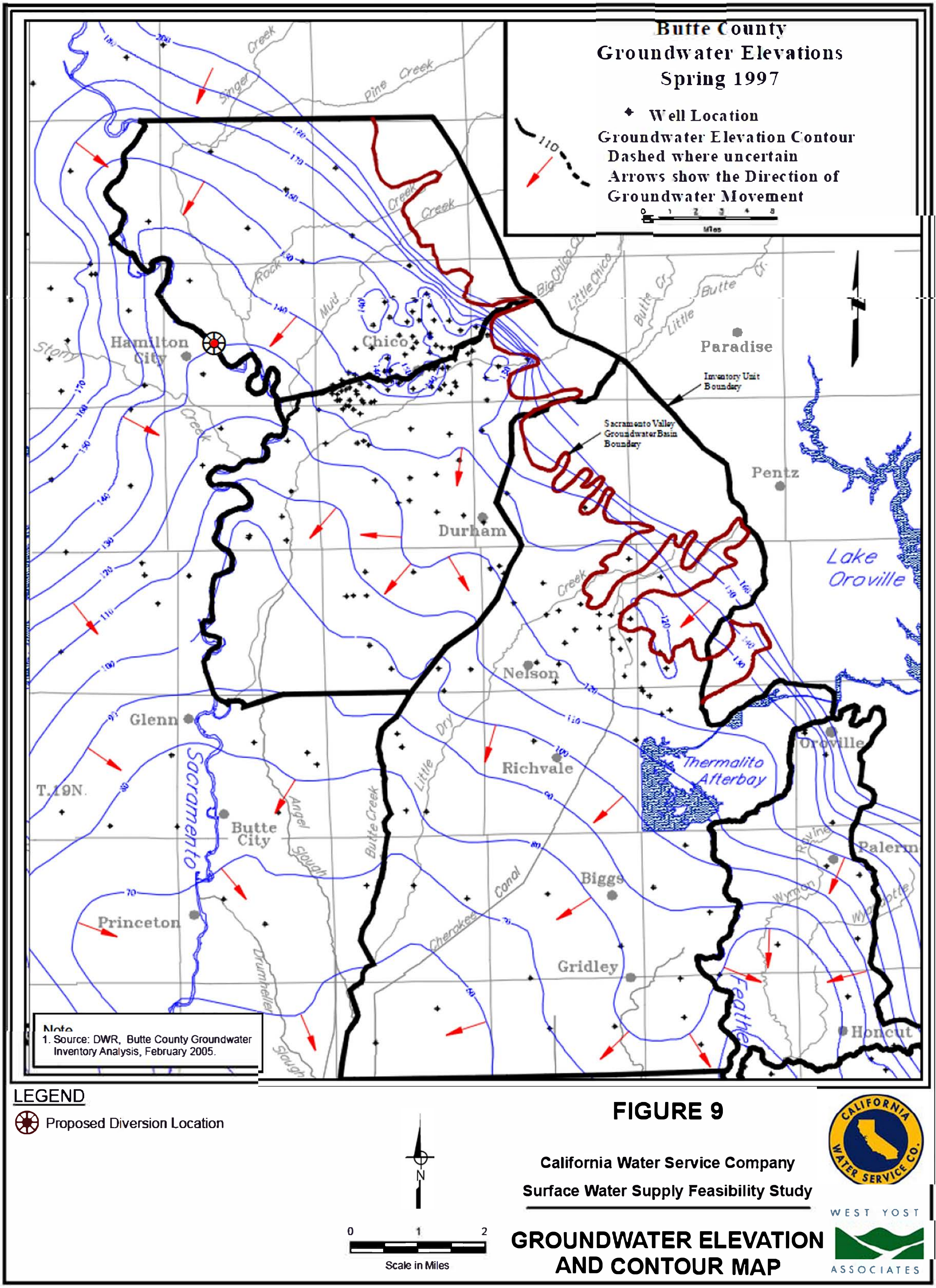

FIGURE 9

California Water Service Company

Surface Water Supply Feasibility Study

GROUNDWATER ELEVATION AND CONTOUR MAP

WEST YOST ASSOCIATES

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Figure 10. Historical Daily Mean Flow Measured for Sacramento River at DWR Station #A0263000

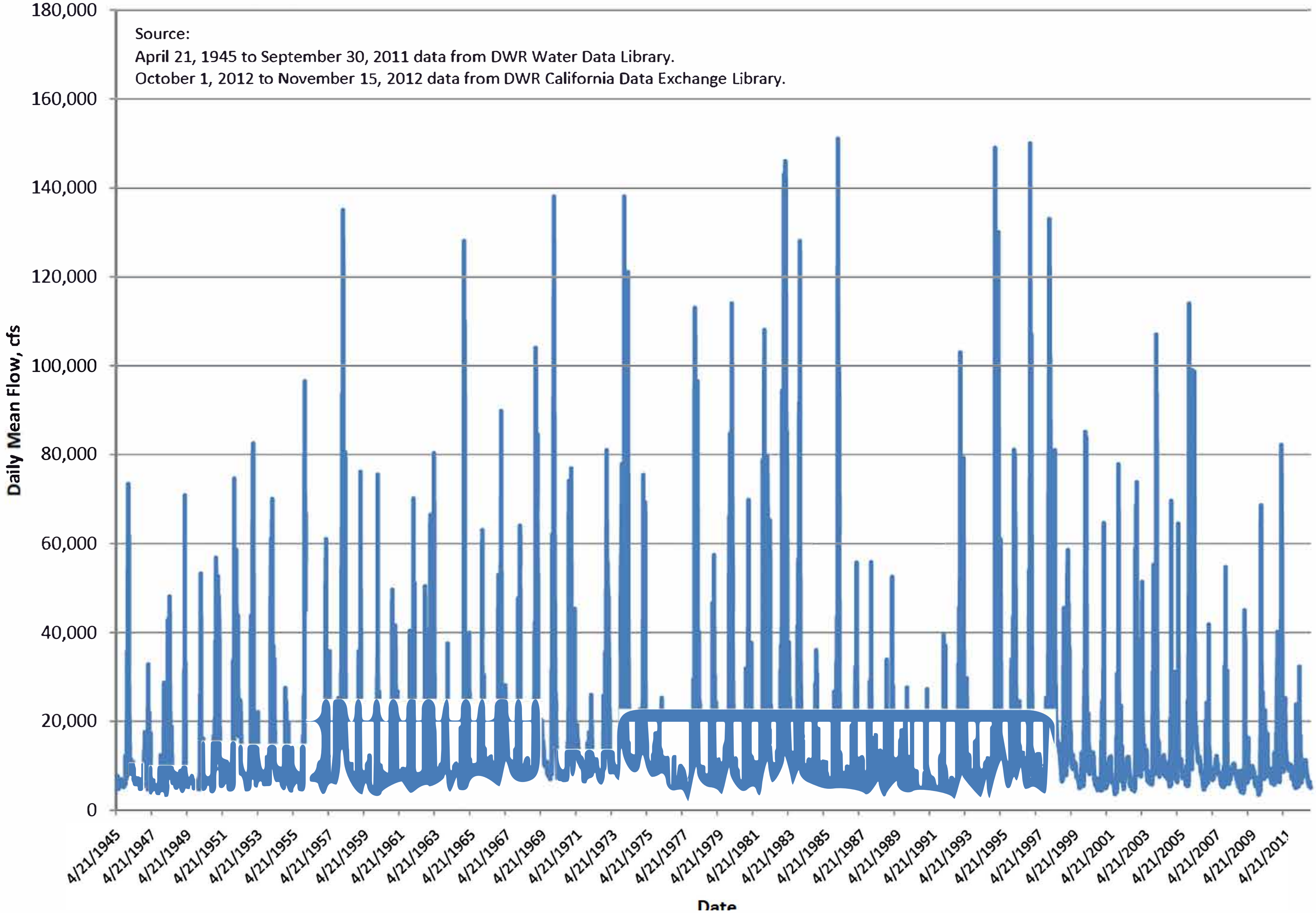

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Figure 11. Historical Daily Mean Water Level Elevation Measured for Sacramento River at DWR Station #A0263000

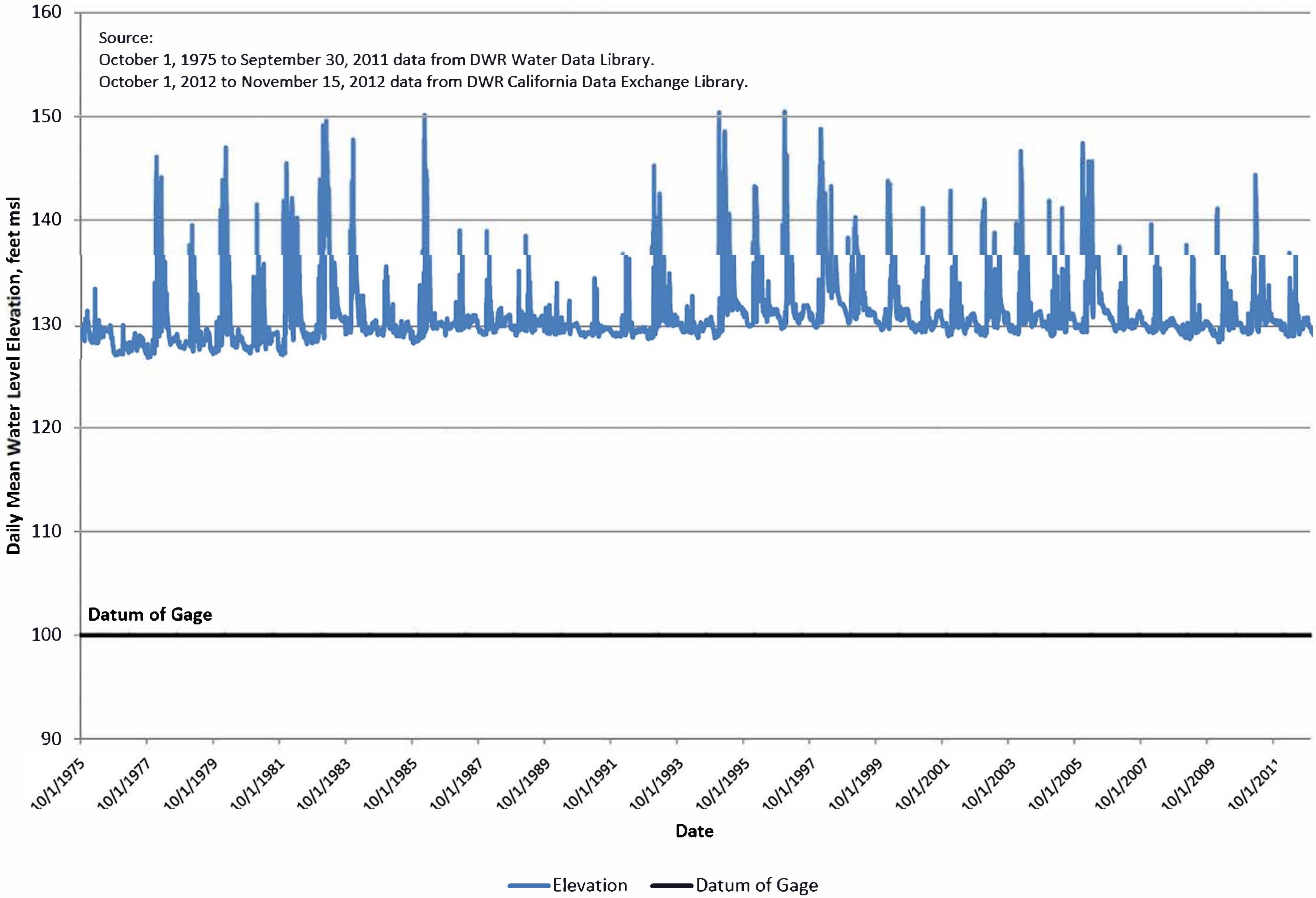

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Figure 12. Average Monthly Temperature Measured for Sacramento River at DWR Station #A0263000

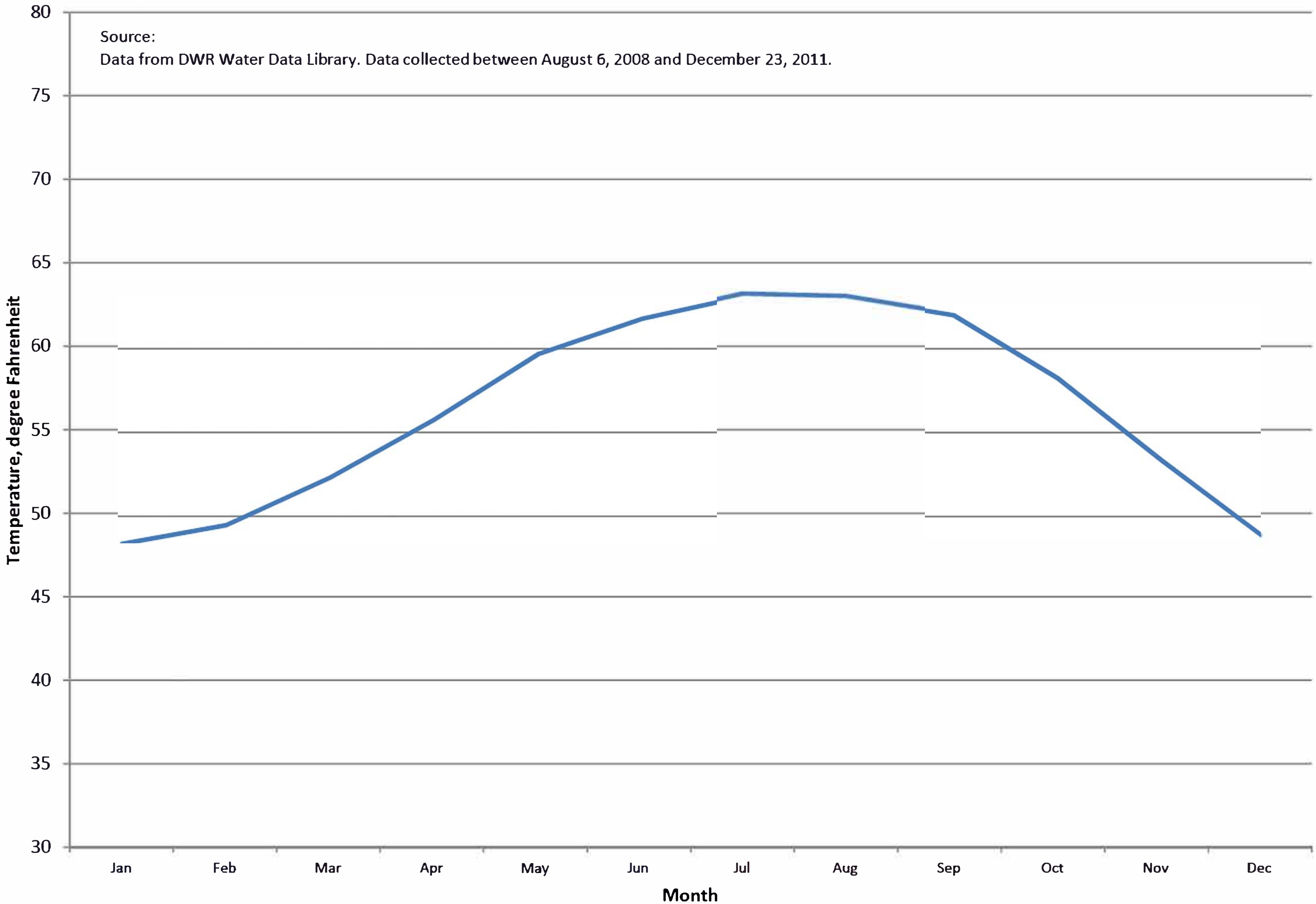

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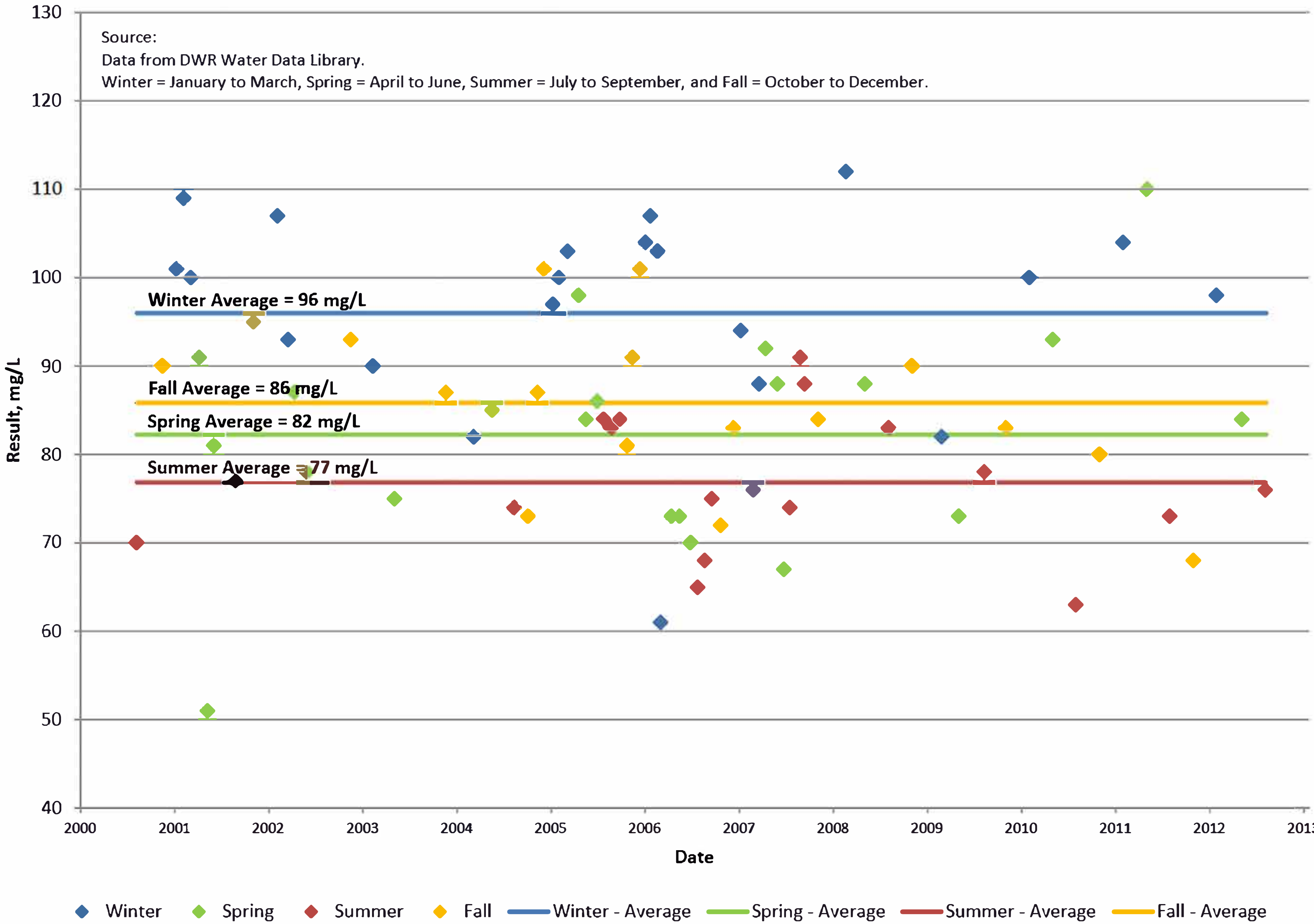
Figure 13. Total Dissolved Solids Measured for Sacramento River at DWR Station #A0263000



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ATTACHMENT A

Butte County Groundwater Inventory Analysis, DWR, February 2005
(Plates 2 to 5)

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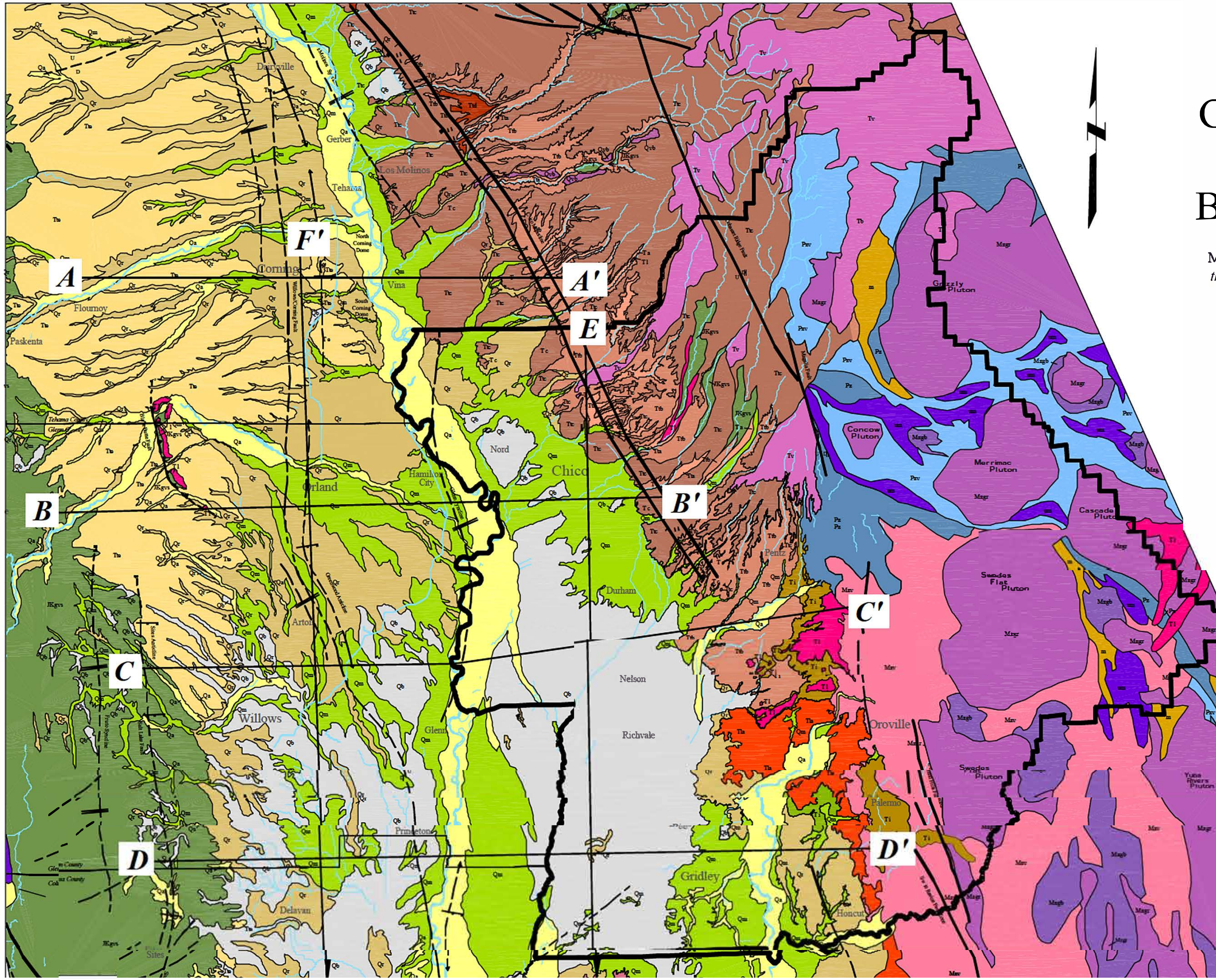


GEOLOGIC MAP OF BUTTE COUNTY

Modified from - *Geology and Hydrogeology of the Freshwater Bearing Aquifer Systems of the Northern Sacramento Valley, California, California Department of Water Resources, Bulletin 118-7, 2001.*

Map Legend

U D **Fault** - dashed where location is approximate; U indicates upthrown side and D indicates downthrown side.

Anticline - Arrows indicate direction of dip.

Syncline - Arrows indicate direction of dip.

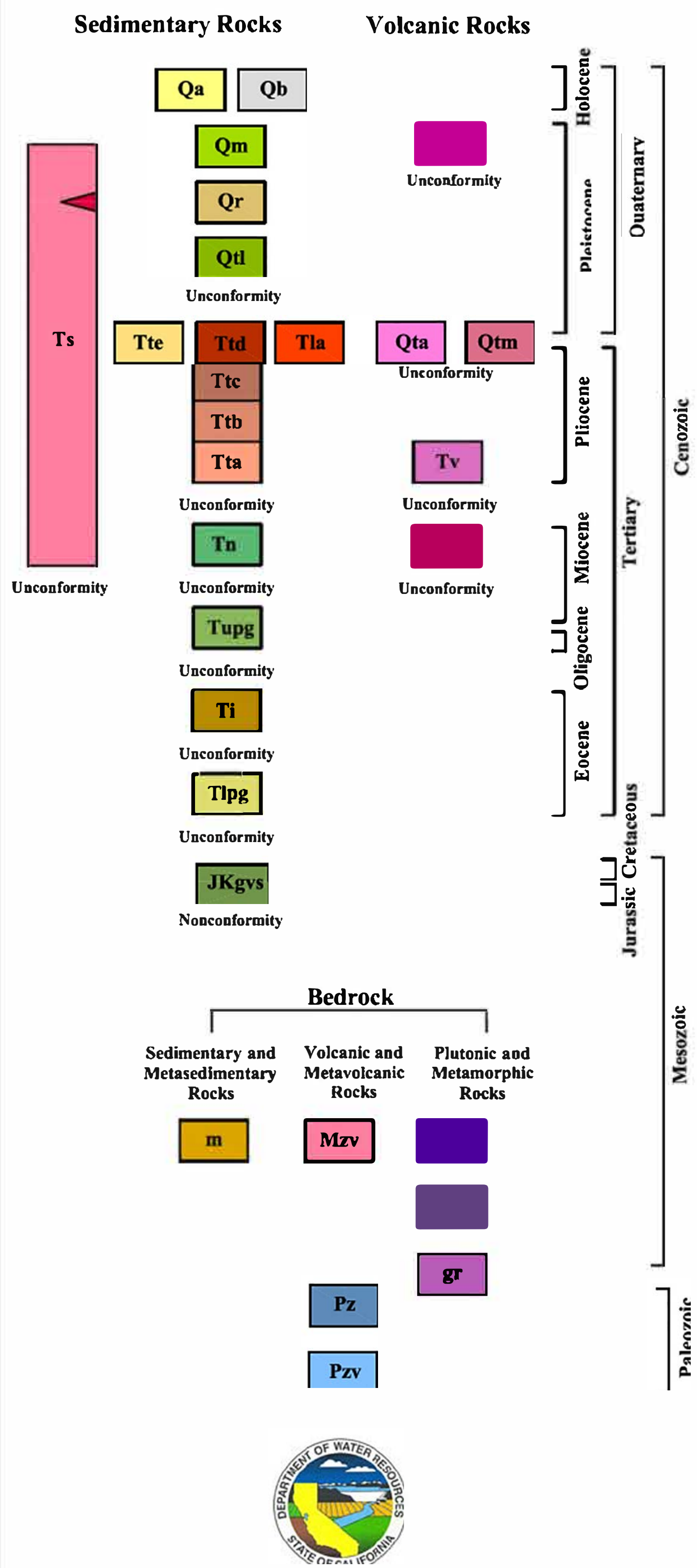
25 **Monocline** - Arrows indicate direction of dip, number indicates steepness of dip in degrees.

D D' **Location of Geologic Cross-Sections** - Letters correspond to geologic sections shown in Plates 4 and 5.

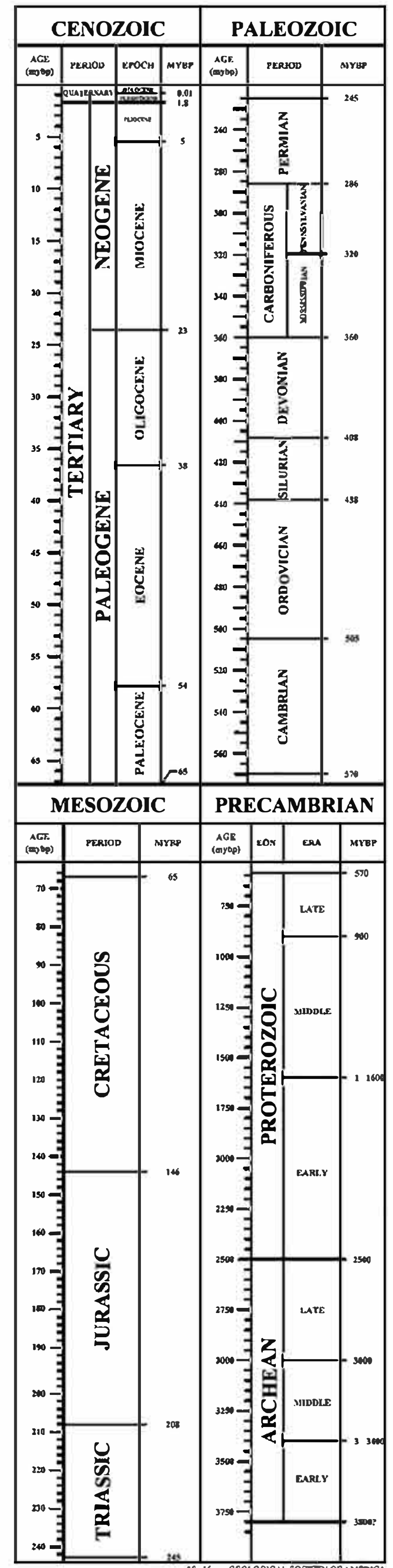
5 0 5 10

MILES

CORRELATION OF MAP UNITS



NORTH AMERICAN GEOLOGIC TIME SCALE



DESCRIPTION OF MAP UNITS

Qa — **Alluvium** (Holocene)-Includes surficial alluvium and stream channel deposits of unweathered gravel, sand and silt, maximum thickness 80 ft. *(adapted from Helley & Harwood, 1985)*.

Qb — **Basin Deposits** (Holocene)-Fine-grained silt and clay derived from adjacent mountain ranges, maximum thickness up to 200 ft. *(adapted from Helley & Harwood, 1985)*.

Qm — **Modesto Formation**, undifferentiated (Pleistocene)-Alluvial fan and terrace deposits consisting of unconsolidated weathered and unweathered gravel, sand, silt and clay; maximum thickness approximately 200 ft. *(adapted from Helley & Harwood , 1985)*.

Qr — **Riverbank Formation**, undifferentiated (Pleistocene)-Alluvial fan and terrace deposits consisting of unconsolidated to semi-consolidated gravel, sand and silt; maximum thickness approximately 200 ft. *(adapted from Helley & Harwood, 1985)*.

Qtl — **Turlock Lake** (Pleistocene)-Weathered and dissected arkosic gravels with minor amounts of resistant metamorphic rock fragments and quartz pebbles, sand and silt; maximum thickness approximately 100 ft. *(adapted from Helley & Harwood, 1985)*.

Qvb — **Volcanic Basalts**, undifferentiated (Pleistocene)-Younger basalt flows found primarily on the east side of the Sacramento Valley, includes minor exposures of andesite; maximum thickness 100 ft. *(adapted from Helley & Harwood, 1985)*.

Qtm — **Tuff Breccia** (Plio-Pleistocene)-Tuff breccia forming outer ring surrounding the Sutter Buttes *(adapted from Helley & Harwood, 1985)*.

Qta — **Volcanic Andesites**, undifferentiated (Plio-Pleistocene)-Younger andesites forming the center of the Sutter Buttes *(adapted from Helley & Harwood, 1985)*.

Tte — **Tehama Formation** (Plio-Pleistocene)-Includes Red Bluff Formation on west side. Pale green, gray and tan sandstone and siltstone with lenses of pebble and cobble conglomerate; maximum thickness 2,000 ft. *(adapted from Helley & Harwood, 1985)*.

Ttd — **Tuscan Unit D** (Plio-Pleistocene)-Fragmental flow deposits characterized by monolithic masses containing gray hornblende and basaltic andesites and black pumice, maximum thickness 160 ft. *(adapted from Helley & Harwood, 1985)*.

Ttc — **Tuscan Unit C** (Plio-Pleistocene)-Includes Red Bluff Formation on east side. Volcanic lahars with some interbedded volcanic conglomerate and sandstone, and reworked sediments; maximum thickness 600 ft. *(adapted from Helley & Harwood, 1985, DWR Bulletin 118-7, 2001, draft report)*.

Ttb — **Tuscan Unit B** (Pliocene)-Layered, interbedded lahars, volcanic conglomerate, volcanic sandstone and siltstone; maximum thickness 600 ft. *(adapted from Helley and Harwood, 1985; DWR Bulletin 118-7, 2001, draft report)*.

Tta — **Tuscan Unit A** (Pliocene)-Interbedded lahars, volcanic conglomerate, volcanic sandstone, and siltstone containing metamorphic rock fragments; maximum thickness 400 ft. *(adapted from Helley & Harwood, 1985; DWR Bulletin 118-7 (in progress), 2001)*.

Tla — **Laguna Formation** (Pliocene)-Interbedded alluvial gravel, sand and silt; maximum thickness 450 feet. *(adapted from Helley & Harwood, 1985; Olmsted and Davis, 1961; DWR Bulletin 118-6, 1978)*.

Tv — **Basalts and Andesites**, undifferentiated (Pliocene)-Older basalts and andesites found on the northeastern portion of the Sacramento Valley and southwest of Winters; maximum thickness up to 230 ft. *(adapted from Helley & Harwood, 1985)*.

Ts — **Sutter Formation** (Late Miocene to Early Pleistocene)-Volcanic fluvatile sediments with lacustrine deposits; maximum thickness approximately 1,800 ft. *(adapted from Garrison, 1962)*.

Tn — **Neroly Formation** (Miocene)-Marine to non-marine sediments, tuffaceous andesitic sandstone with interbeds of tuff and tuffaceous shales and occasional conglomerate lenses; max. thickness 500 ft. *(adapted from Redwine, 1972; Wagner and Saucedo, 1990)*.

Tl — **Lovejoy Basalt** (Miocene)-Black, dense, hard microcrystalline basalt; maximum thickness 65 ft. *(adapted from Helley & Harwood, 1985)*.

Tupg — **Upper Princeton Valley Fill** (Late Oligocene to Early Miocene)-Non-marine sediments composed of sandstone with interbeds of mudstone and occasional conglomerate and conglomerate sandstone; maximum thickness 1,400 ft. *(adapted from Redwine, 1972)*.

Ti — **Ione Formation** (Eocene)-Marine to non-marine deltaic sediments, light colored, commonly white conglomerate, sandstone and siltstone, which is soft and easily eroded; max. thickness 650 ft. *(adapted from DWR Bulletin 118-6, 1978; Creely, 1965)*.

Tlpg — **Lower Princeton Submarine Valley Fill** (Eocene)-includes Capay Formation. Marine sandstone, conglomerate and interbedded silty shale, maximum thickness 2,400 ft. (*adapted from Redwine, 1972*)

JKgvs — **Great Valley Sequence** (Late Jurassic to Upper Cretaceous)-Marine clastic sedimentary rock consisting of siltstone, shale, sandstone and conglomerate; maximum thickness 15,000 ft.

m — **Mixed Rocks** (pre-Cenozoic)-Undivided metasedimentary and metavolcanic rocks of greatly varying types *(adapted from Jennings, 1977)*.

Mzv — **Volcanic and Metavolcanic Rocks** (Mesozoic)-Undivided volcanic and metavolcanic rocks, andesite rhyolite flow rocks, greenstone and volcanic breccia *(adapted from Jennings, 1977)*.

um — **Ultramafic Rocks** (Mesozoic)-Primarily composed of serpentine, with peridotite, gabbro and diabase *(adapted from Jennings, 1977)*.

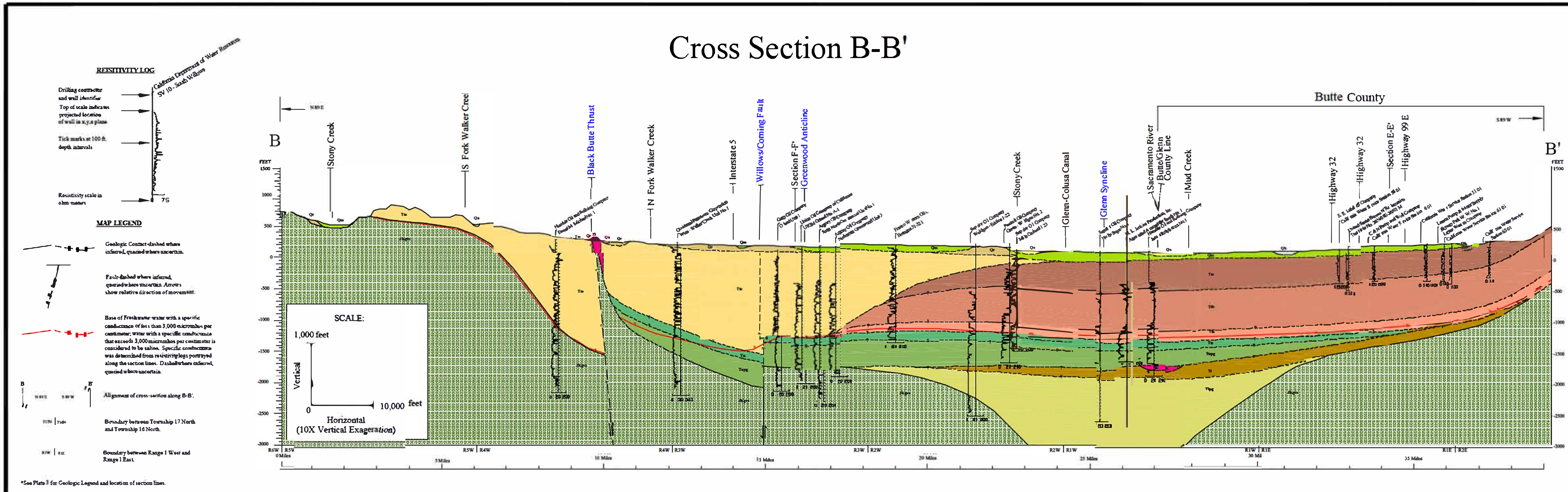
gb — **Gabbro** (Mesozoic)-Gabbro and dark diotric rocks *(adapted from Jennings, 1977)*.

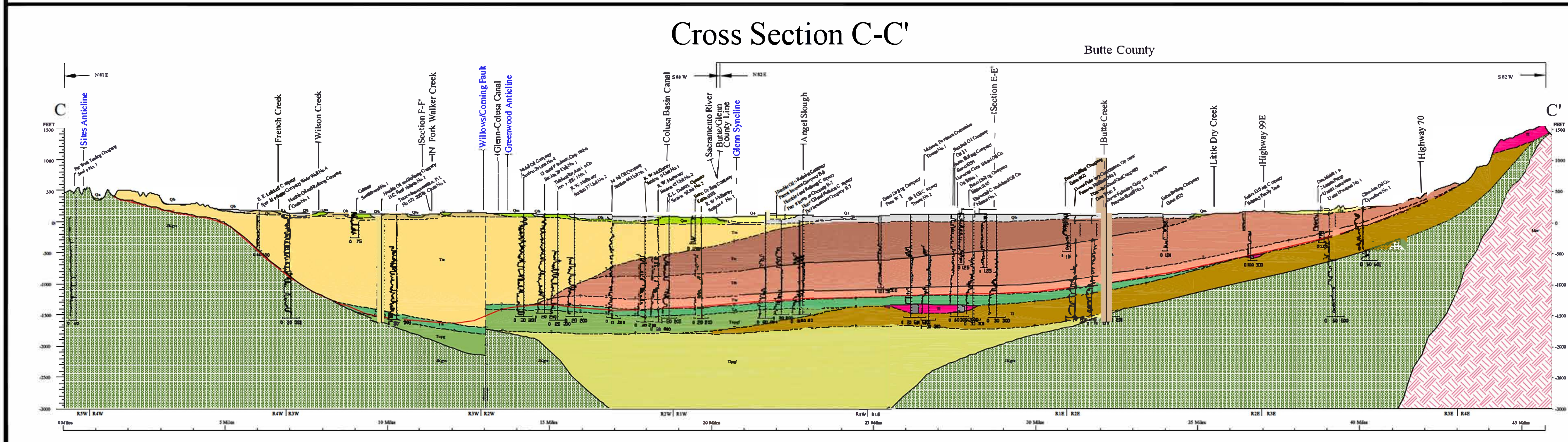
gr — **Undifferentiated Granitic Plutons** (Mesozoic-Paleozoic)-Undivided granitic plutons and related rocks *(adapted from Jennings, 1977)*.

Pz — **Paleozoic Metasedimentary Rocks** (Paleozoic)-Undivided metasedimentary rocks including slate, shale, sandstone, chert, conglomerate, limestone, dolomite, marble, phyllite,schist, hornfels and quartzite *(adapted from Jennings, 1977)*.

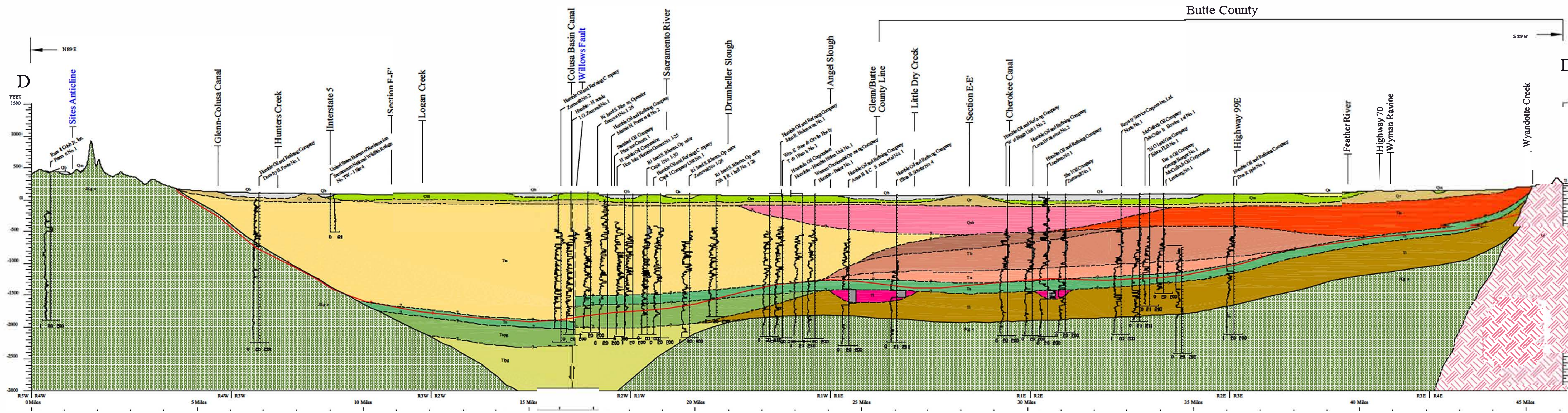
Pzv — **Paleozoic Metavolcanic Rocks** (Paleozoic)-Undivided metavolcanic rocks, primarily flows, breccia, and tuff, including greenstone, diabase and pillow lavas *(adapted from Jennings, 1977)*.

PLATE 4

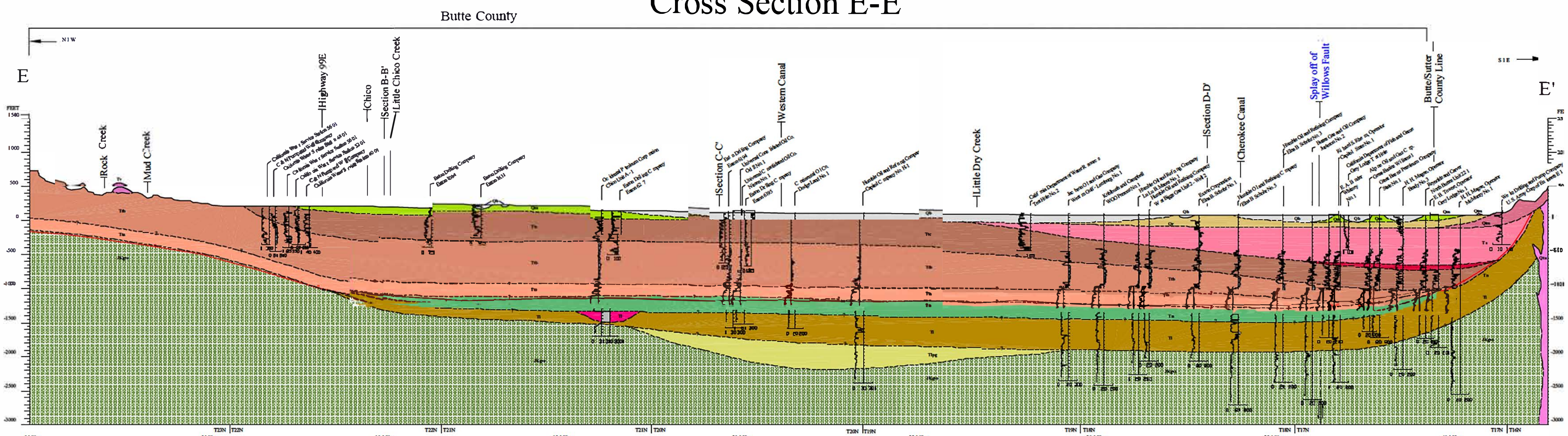

Cross Section B-B'
RESISTIVITY LOG
MAP LEGEND
SCALE:
1,000 feet
Vertical
10,000 feet
Horizontal
(10X Vertical Exageration)
Stony Creek
S Fork Walker Cree
Black Butte Thrust
N Fork Walker Creek
Interstate 5
Willows/Corning Fault
Section F-F'
Greenwood Anticline
Stony Creek
Glenn-Colusa Canal
Glenn Syncline
Sacramento River
Butte/Glenn County Line
Mud Creek
Highway 32
Highway 32
Section E-E'
Highway 99 E
Butte County
B
B'
*See Plate 3 for Geologic Legend and location of section lines.


Cross Section C-C'
Butte County
C
C'
Sites Anticline
French Creek
Wilson Creek
Section F-F'
N Fork Walker Creek
Willows/Corning Fault
Glenn-Colusa Canal
Greenwood Anticline
Colusa Basin Canal
Sacramento River
Butte/Glenn County Line
Glenn Syncline
Angel Slough
Section E-E'
Butte Creek
Little Dry Creek
Highway 99E
Highway 70

Cross Section D-D'



Cross Section E-E'



ATTACHMENT B

Caltrans Geotechnical Investigation for Bridge No. 12-54

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State of California | Business, Transportation and Housing Agency

Memorandum

To : R. C. Cassano, Chief
Office of Structures Design
Division of Project Development

Attention: Phil Hale
Design Section 6

Date : December 28, 1984

File : 3-BUT-32
03209 - 158121

Sacramento River
Bridge (Gianelli)
Bridge No. 12-54

From : DEPARTMENT OF TRANSPORTATION - 739-5435
Office of Transportation Laboratory

Subject: FOUNDATION RECOMMENDATIONS

This report presents the results of a geotechnical investigation for the proposed Sacramento River Bridge at Hamilton City (Gianelli). The scope of this investigation was to provide information regarding subsurface conditions and to provide foundation recommendations for design and construction. The work was performed by the Geotechnical Branch of the California Transportation Laboratory.

Exploration

Subsurface conditions at the site were explored by drilling five 15.5-foot to 65.5-foot deep 3-inch diameter rotary wash borings. At approximately 5-foot intervals, either standard penetration tests were performed with a 1.4-inch ID split spoon sampler, or 2-inch diameter Modified California Tube samples were taken. In some instances subsurface conditions prevented sampling.

The "Log of Borings", will be transmitted when completed.

Site Geology and Groundwater Conditions

The site is underlain by Quaternary alluvial flood plain and channel deposits. The flood plain deposits encountered at the abutments and those visible along the banks are very soft organic silty clays and loose to compact silts and very fine to fine sands. Compact to very dense sandy gravels were encountered below elevation 124 at the east bank and in the existing river channel. Recovery from split spoon samples indicates the presence of pebble and cobble size particles. The sandy gravels in the channel above the maximum depth-of-scour are compact to dense. Deposits below this depth are very dense. The maximum depth to which the borings penetrated is elevation 68.

Recent scour depths range from elevation 112 to 126.

Groundwater levels at the abutments are the same as the river level.

Laboratory Test Results

Two consolidation tests and one series of Consolidate Undrained triaxial tests are being performed on samples of the east abutment flood plain deposits. When available, the results will be analyzed for abutment slope stability and settlement. The results and conclusions will be transmitted when completed.

Seismic Data

The nearest known active fault is the Cleveland Hill Fault, located approximately 30 miles southeast of the site. The maximum credible rock acceleration generated at this site is 0.1g. Rock-like material is greater than 150 feet below the surface. Soil liquefaction at the abutments above elevation 124 is possible, but is not considered a potential hazard to the structure because of the depth of the pile foundation.

Foundation Recommendations

A combination of Class 70 piles and driven 100 ton HP 14 89 steel H-piles are recommended for the bridge shown on the "General Plan", dated November 29, 1984.

Pile tip recommendations are as follows:

Location	Pile Type	Pile Design Capacity	Specified Tip Elev.	Estimated Tip Elev.
Abutment 1*	Class 70	70 ton	119	114
Piers 2-7	HP 14 89	100 ton	60	55
Abutment 8	Class 70	70 ton	119	114

* The abutment 1 pile tip recommendation is provisional. Final tip recommendations will be available when weather conditions allow further exploratory drilling. A supplementary foundation report will be sent at that time.

Piers 3 through 6 pile caps should be founded at or below elevation 100.

It may be necessary to provide the steel piles with a driving tip to protect pile integrity and facilitate penetration to the specified tip. Difficult driving conditions in the sandy gravels may be encountered.

Additional Recommendations and Comments

Settlement periods and amounts, surcharge requirements, and approach slab recommendations will be transmitted when the laboratory tests have been completed and the results analyzed.

Sheet-pile cofferdams will have to be constructed for pier 3 through 6 pile caps, and possibly for piers 2 and 7. Tremie seal plugs may also be necessary.

River flow estimates supplied by DWR Sutter Station indicate a June to September range of 8000 to 20,000 second-feet. More accurate and up-to-date information need to be obtained for construction purposes.

Average river sectional velocities of 4 fps are typical, with maximum point velocities in the 10-14 fps range. Conditions will necessitate the use of a trestle causeway to reach the piers and to support the bridge falsework.

Abutment slope protection specified by the Corps of Engineers at this location has been reviewed by District 3 and TransLab personnel. Care should be taken to protect the bent 2 and 7 locations from excessive erosion during construction.

Provisions should be made for transportation lab personnel to monitor the driving of a pier 7 production pile using the dynamic analyzer. A monitored restrike is necessary at least 24 hours after completion of the initial driving to complete the analysis.

Any additional questions regarding the foundation may be directed to the Geotechnical Branch of the Transportation Laboratory.

Ronald L. Richman

Ronald L. Richman
Assistant Transportation Engineer
Geotechnical Branch

Wilfred S. Yee

Wilfred S. Yee
Associate Materials and Research Engineer
Geotechnical Branch

RR:mgc

cc: Preliminary Report
R. E. Pending File
District (2)
FHWA - D. F. Bolton
TransLab - R. A. Forsyth
A. Goldschmidt
Geotech (5)

State of California — Business, Transportation and Housing Agency

Memorandum

To : R. C. Cassano, Chief
Office of Structures Design
Division of Project Development

Attention: Phil Hale
Design Section 6

Date : January 30, 1985

File : 3-But-32
03209 - 158121

Sacramento River Bridge (Gianelli)
Bridge No. 12-54

From : **DEPARTMENT OF TRANSPORTATION** - 739-5435
Office of Transportation Laboratory

Subject : Foundation Recommendations

The following is a summary of laboratory results from the tests performed on 2-inch Modified California tube samples obtained as part of the foundation investigation for the Sacramento River Bridge (Gianelli). These samples were obtained from soils underlying the proposed location of Abutment 8.

Sample	Depth Feet	Unit Wt pcf	Moist %	Grain Size Gr	Grain Size Sd	Grain Size Si	Grain Size Cl	Plasticity PL	Plasticity LL	Plasticity PI
B6-1-III	15'2"	115.0	37.3	0	15	68	17			
B6-1-I	15'10"	123.0	27.1	0	64	28	8			
B7-1-I	11'5"	108.6	37.5	0	37	55	8			
B7-2-III	14'2"	115.7	35.3	0	35	52	13	27	29	2
B7-2-II	14'6"	113.9	31.7	0	45	45	10			
B7-2-I	14'10"	113.8	30.5	0	51	41	8	-	-	NP

In addition to these tests, consolidated undrained triaxial tests with excess pore pressure measurements were performed on samples B7-2-I, B7-2-II and B7-2-III. The total internal friction angle and cohesion are 27 degrees and 360 psf. Slope stability analysis using a circular failure surface indicates no stability problems at the abutments.

Consolidation tests were performed on samples B6-1-III and B7-1-I. Settlement analysis indicates a total settlement of approximately 0.6 foot at the location of the greatest fill height. Primary consolidation amounting to about 0.23 foot will take place immediately upon loading. The remaining settlement is secondary and will take place at a rapidly decreasing rate. Total settlement will reach 0.36 foot in 30 days and 0.38 foot in 60 days. Therefore, a 30-day settlement period and Type 1 approach slabs are recommended. Also, import fill quantities should be adjusted to accommodate settlement.

Soil conditions and recommendations for Abutment 1 may be assumed identical to those outlined here. Their validity will be addressed after the Abutment 1 site is investigated this spring.

Additional questions regarding the foundation may be directed to the Geotechnical Branch of the California Transportation Laboratory.

Ronald L. Richman

Ronald L. Richman
Assistant Transportation Engineer
Geotechnical Branch

RLR:db

12-0054

DATE 11-27-84 GIANELLI RIVER BR

SPANS 100 - 115 - 135 - 162 - 135 - 115 - 100

L = 862'

			DL		LL		TOTAL
Ab 1	26+56		600	+	240	=	840 KIPS
		100					
BT 2	27+56		2190	+	407	=	2597 K
		115					
BT 3	28+71		2452	+	430	=	2882 K
		135					
BT 4	30+06		2862	+	470	=	3332 K
		162					
BT 5	31+68		2862	+	470	=	3332 K
		135					
BT 6	33+03		2452	+	430	=	2882 K
		115					
BT 7	34+18		2190	+	407	=	2597 K
		100					
Ab 8	35+18		600	+	240	=	840 K

State of California | Business, Transportation and Housing Agency

Memorandum

To : R. C. Cassano, Chief
Office of Structures Design
Division of Project Development

Attention: Phile Hale
Design Section 6

Date : February 13, 1985

File : 3-BUT-32
03209 - 158121

Sacramento River Bridge (Gianelli)
Bridge No. 12-54

From : DEPARTMENT OF TRANSPORTATION
Office of Transportation Laboratory

Subject: ADDENDUM TO FOUNDATION RECOMMENDATIONS

This report contains the results of a geotechnical investigation for abutment 1 of the Sacramento River Bridge at Hamilton City (Gianelli). This work completes the foundation investigation process for this structure.

EXPLORATION

One 35.8 foot deep 3-inch diameter rotary wash boring was drilled at the site of proposed abutment 1. Standard penetration tests were performed with a 1.4-inch ID split spoon sampler at 5-foot intervals.

SITE GEOLOGY

The site is underlain by approximately 13.5 feet of loose to slightly compact very fine sand. Below this are gravelly sands and sandy gravels with consistencies ranging from compact to very dense.

FOUNDATION RECOMMENDATIONS

70 ton design capacity class 70 driven piles are recommended. Specified and estimated pile tip elevations are 119 and 114, respectively. These tips are identical to those provided in the initial report dated December 28, 1984. Alternatives 'V' and 'W' should be eliminated from the contractor's options due to the possibility of damage during driving. This applies to both abutments.

Settlement at the abutment will occur immediately upon loading and is calculated to be 0.27 foot. Fill quantities should be adjusted accordingly. A 30-day embankment settlement period is recommended.

Any additional questions regarding the foundation may be directed to the Geotechnical Branch of the Transportation Laboratory.

Ronald L. Richman

Ronald L. Richman
Assistant Transportation Engineer
Geotechnical Branch

RR:tp

cc: Preliminary Report
R.E. Pending File
District (2)
FHWA - D.F. Bolton
TransLab - R.A. Forsyth
A. Goldschmidt
Geotech (5)

State of California

Business and Transportation Agency

Memorandum

To: Mr. R. C. Cassano
Chief, Office of Structures Design

Attention: Mr. C. D. Harris
Preliminary Investigation Section

SACRAMENTO RIVER BR (GIANELLI)	Bridge Name
12-54	Bridge Number
03-BUT-32-0.5	Dist-Co-Rte
03209 - 158121	Work Order Numbers
3/14/84 PS&E 6/12/85	Date

From : DEPARTMENT OF TRANSPORTATION , TRANSPORTATION LABORATORY
Engineering Geology and Technical Services Branch 739-2483

Subject: PRELIMINARY GEOLOGIC INFORMATION

Geologic Data

Thickness of Alluvium >150' (depth to rock-like material)

Use Design Force Coefficient Curve 0'-10'____, 10'-80'____,
80'-150____, or 150'+ ✓.

Type of Alluvial Material silts, sands and gravels, some clayey zones

Earthquake Data

Fault Cleveland Hill

Magnitude 6½

Distance to Site from Fault ~30 miles

Maximum Horizontal Bedrock Acceleration 0.1g

Foundation Data

70 ton driven piles and/or large diameter [illegible]
[illegible] steel piles [illegible]

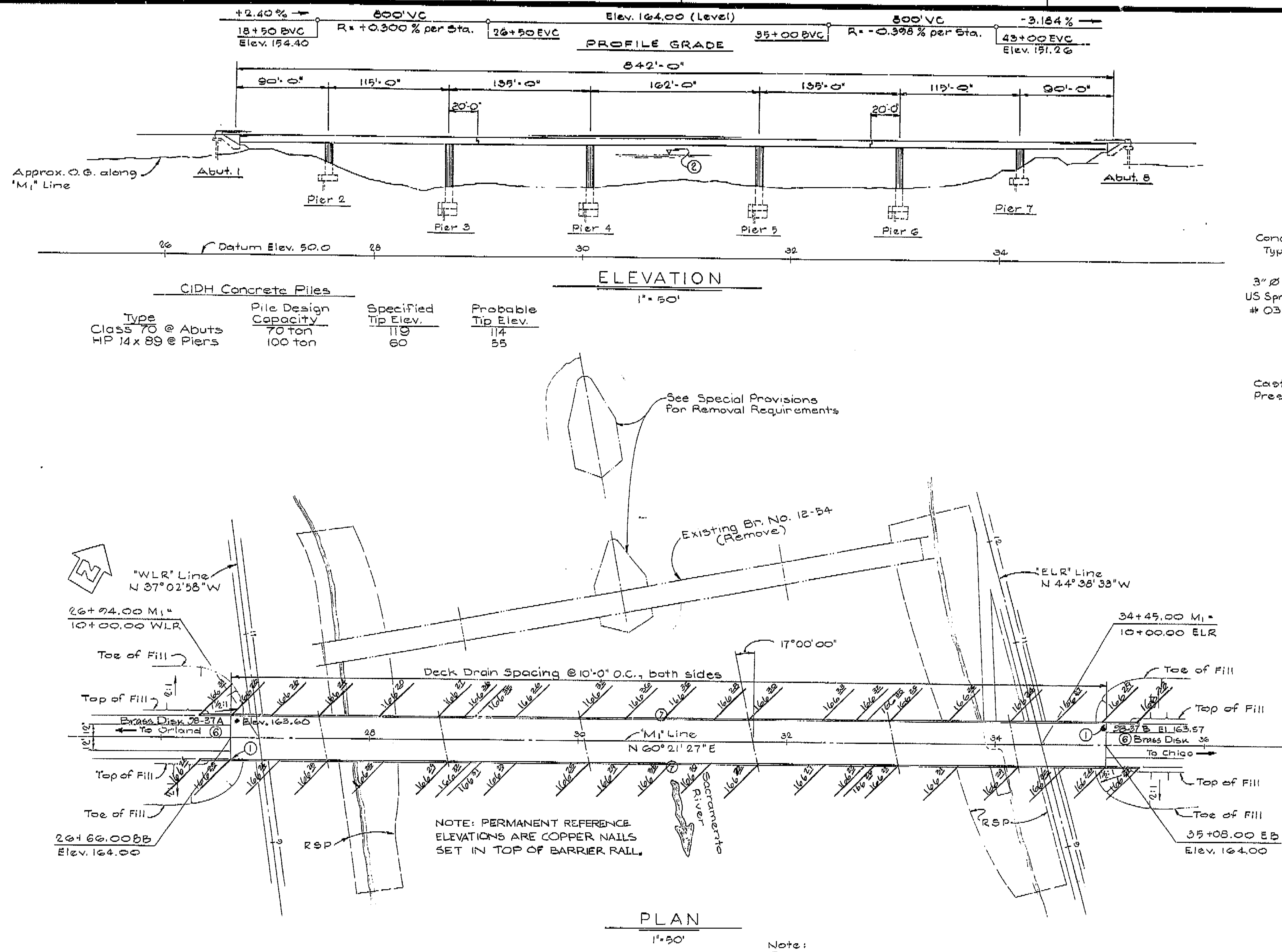
Remarks

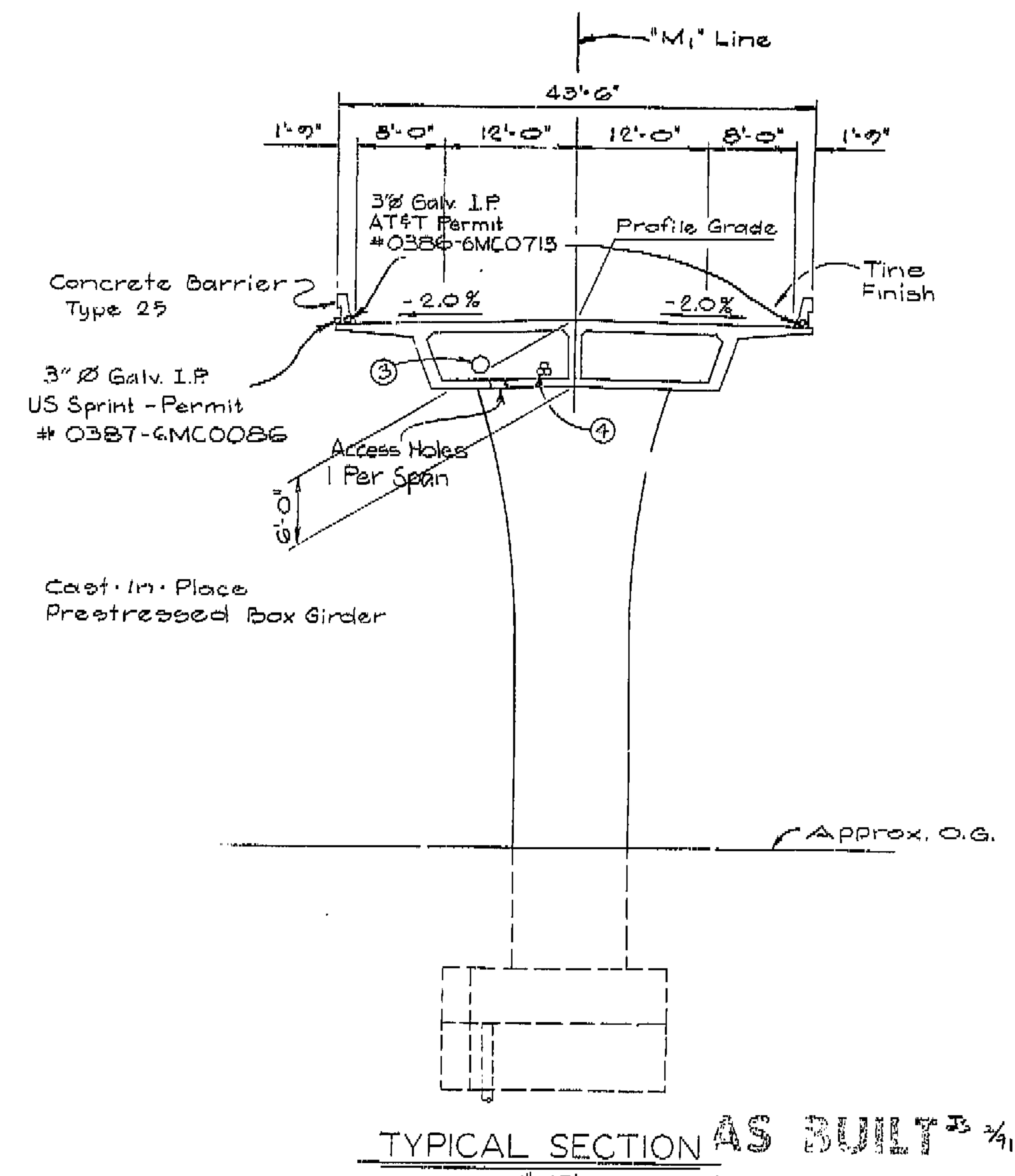
existing bridge adjacent to proposed alignment is [illegible]
wooden piles

pile cap elevations will consider scour,
rock slope protection will be needed at the abutments

Prepared By: Ronald J. Richman

Orig: Design Section
Copy: EG&TS Branch JOB FILE





TYPICAL SECTION
1" = 10'

AS BUILT

CORRECTIONS BY E. Bntz

CONTRACT NO. 158124

DATE 1-10-91

INDEX TO PLANS

SHEET NO.	TITLE
1	GENERAL PLAN
2	FOUNDATION PLAN NO. 1
3	FOUNDATION PLAN NO. 2
4	ABUTMENT DETAILS
5	PIER DETAILS
6	HINGE RESTRAINER DETAILS
7	HINGE DETAILS
8	TYPICAL SECTION
9	GIRDER LAYOUT
10	JOINT SEAL ASSEMBLY
11	STRUCTURE APPROACH DETAILS NO. 1
12	STRUCTURE APPROACH DETAILS NO. 2
13	MISCELLANEOUS DETAILS
14	LOG OF TEST BORINGS

STANDARD PLANS DATED JULY 1984

A-62C	EXCAVATION AND BACKFILL - LIMITS OF PAYMENT (BRIDGE)
BO-1	BRIDGE DETAILS
BO-3	BRIDGE DETAILS
BO-5	BRIDGE DETAILS
BO-13	BRIDGE DETAILS
B2-5	PILE DETAIL CLASS 45 & CLASS 70
B6-21	JOINT SEALS
B7-1	BOX GIRDER DETAILS
B7-10	UTILITY OPENING - BOX GIRDER
B8-5	CAST-IN-PLACE PRESTRESSED GIRDER DETAILS
B11-53	CONCRETE BARRIER TYPE 25

Note:
1 ~ Paint "Sacramento River Br." & "Br. No. 12-54".
2 ~ For Hydrologic Summary see "Foundation Plan No. 1" sht.
3 ~ 20" utility opening for 16" gas casing
4 ~ 3 - 4"φ conduit for Pacific Bell.
5 ~ For General Notes see "Foundation Plan No. 1" sheet.
6 ~ Structure Approach Slab
7 ~ See Road Plans for rail mounted signs.

Standard Plan Sheet No.
Detail No.

DIST.	COUNTY	ROUTE	POST MILES—TOTAL PROJECT	SHEET	TOTAL SHEETS
03	Gle,But	32	10.5/10.3, 0.0/0.4	35	48

CHIEF, OFFICE OF STRUCTURES DESIGN — REGISTERED CIVIL ENGINEER NUMBER 11428

DATE APPROVED January 27, 1986

Submitted by: Robert W. Baily C-9584 — DESIGN ENGINEER, REGISTERED CIVIL ENGINEER NUMBER

Approval Recommended by: ... 8198 — DESIGN SUPERVISOR, REGISTERED CIVIL ENGINEER NUMBER

	By		Checked	
DESIGN	E. BRUNBERG	11/84	ADE AKINSANYA	4/85
DETAILS	E. Yamagida	10/84	ADE AKINSANYA	
QUANTITIES		4/85	DD	

LOAD FACTOR DESIGN

LIVE LOADING: HS20-44 AND ALTERNATIVE AND PERMIT DESIGN LOAD

LAYOUT — By E. BRUNBERG 9/84 — Checked ADE AKINSANYA

SPECIFICATIONS — By R. B. Eigg 8/98 — Plans and Specs Compared

State of CALIFORNIA
DEPARTMENT OF TRANSPORTATION

STRUCTURES - DESIGN 6

E. N. Brunberg 20243 — PROJECT ENGINEER, REGISTERED CIVIL ENGINEER NO.

BRIDGE NO. 12-54

POST MILE 0.0

SACRAMENTO RIVER BRIDGE

GENERAL PLAN

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 03209
WO 158121

Disregard prints bearing earlier revision dates

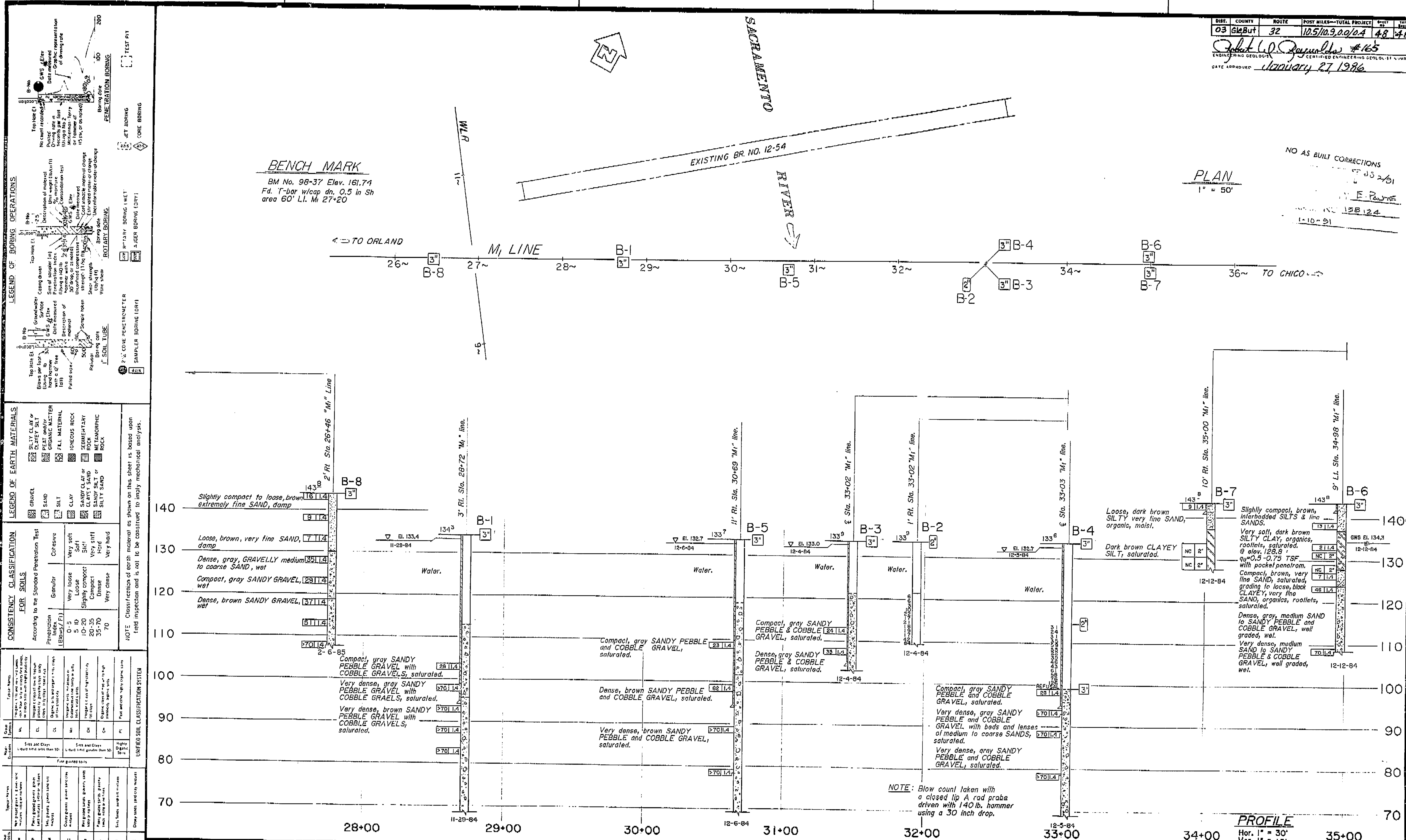
REVISION DATES (PRELIMINARY STAGE ONLY)

SHEET 1 OF 14

AS BUILT PLANS
Contract No. 03-158124
Date Completed 1-10-91
Document No.

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF TRANSPORTATION.

DATE 5-1-91 SIGNATURE Donald Blackford TITLE ... SERVICES



DIST.	COUNTY	ROUTE	POST MILES—TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
03	Gle,But	32	10.5/10.9,0.0/0.4	48	48

Robert W. Reynolds #165
ENGINEERING GEOLOGIST — CERTIFIED ENGINEERING GEOLOGIST NUMBER
DATE APPROVED January 27 1986

GEOTECHNICAL BRANCH - TRANSPORTATION LABORATORY

DRAWN BY: ED FONG - I. HOWELL 1/85
CHECKED BY:
Ronald L. Richman — PROJECT ENGINEER
Recommended by: H. C. Jackura — ENGINEER 22013

State of **CALIFORNIA**
DEPARTMENT OF TRANSPORTATION

STRUCTURES - DESIGN 6
E. N. Brumberg 20243 — PROJECT ENGINEER, REGISTERED CIVIL ENGINEER NO.

BRIDGE NO. 12-54
POST MILE 0.0

SACRAMENTO RIVER BRIDGE
LOG OF TEST BORINGS

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

CU 03209
WO 158121

Disregard prints bearing earlier revision date
REVISION DATES (PRELIMINARY STAGE ONLY) 3/12/85
SHEET 14 OF 14

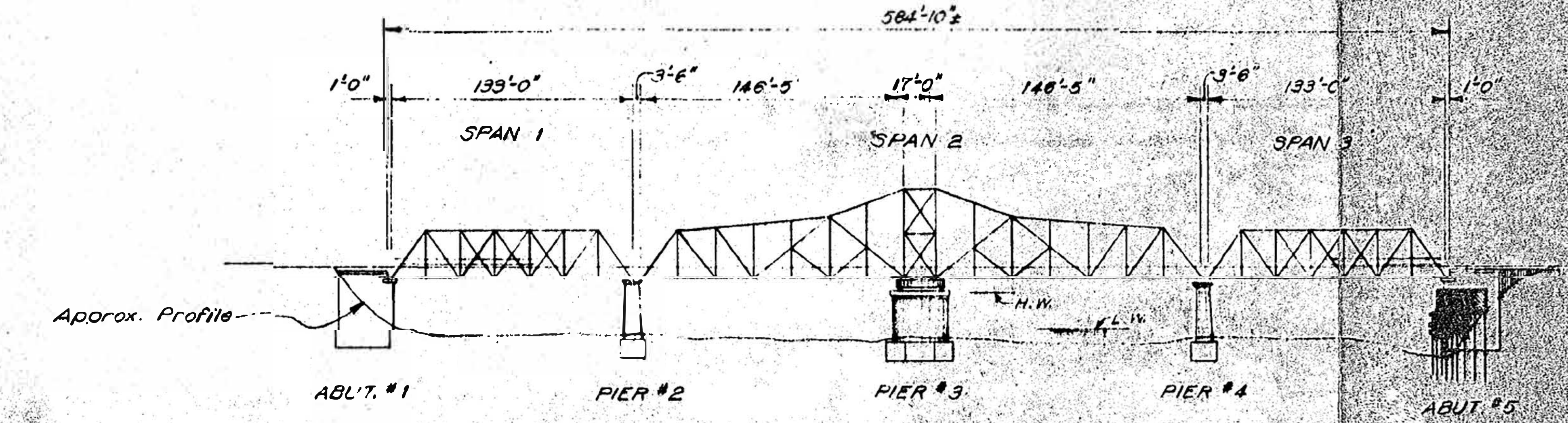
48

AS BUILT PLANS
Contract No. 03-158124
Date Completed 1-10-91
Document No.

UNIT I

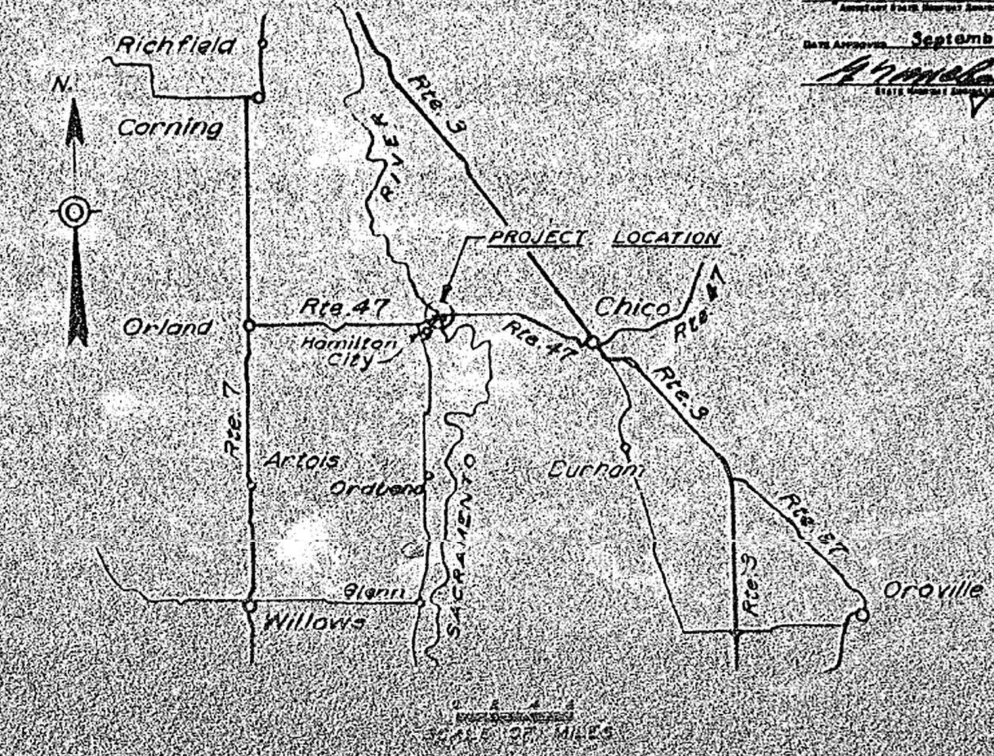
Dist.	County	Route	Section	Sheet No.	Total Sheets
II	But	47	A	1	5

September 2, 1958

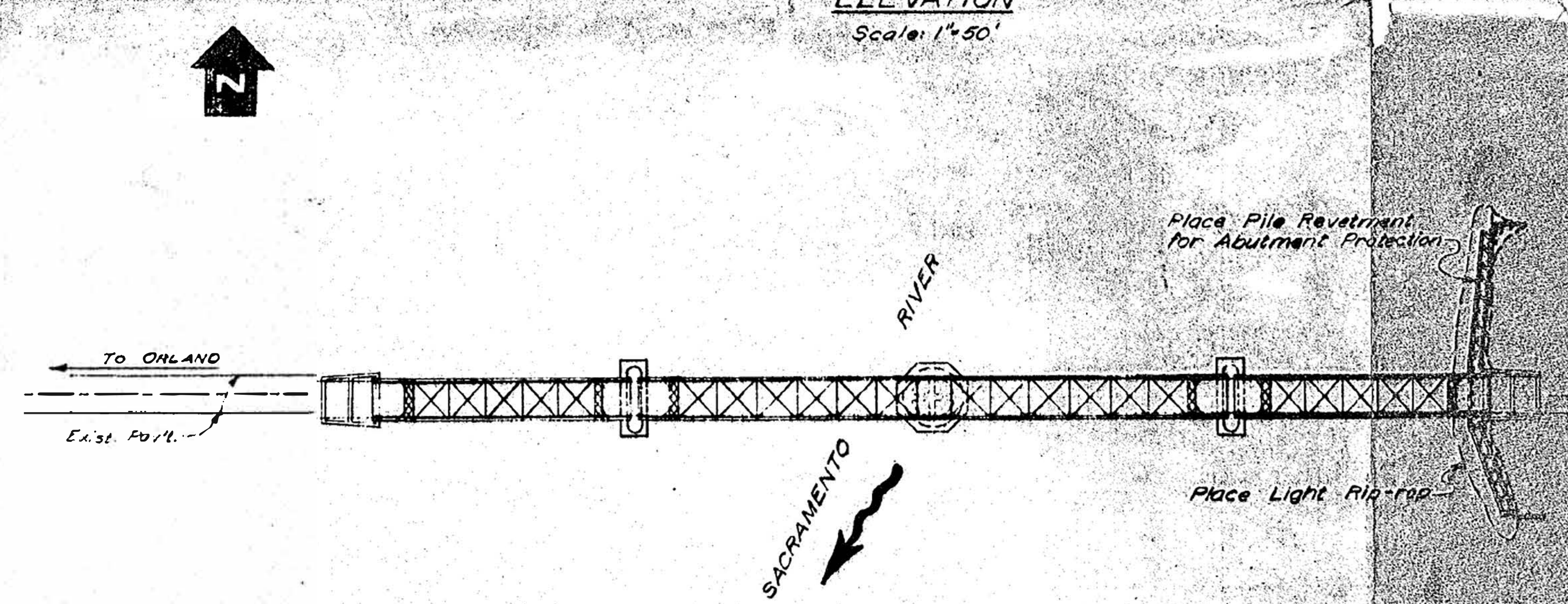


ELEVATION

Scale: 1"=50'



LOCATION MAP



PLAN

Scale: 1"=50'

GENERAL NOTES

1. Construction Specifications: Standard Specifications, Division of Highways, dated ... and the Special Provisions.
2. Piles to be Treated Douglas Fir.
3. Timber to be Treated Douglas Fir, Construction Grade.
4. Bridge and Timber to be treated with Creosote by 10 pound empty cell process.
5. All hardware to be galvanized.

AS BUILT

INDEX TO PLANS

Sheet	Title
1	General Plan
2	Layout Plan
3	Elevations and Sections
4	Site Plan (exist. conditions)
5	Log of Test Borings

Note: See "Site Plan" for Bench Marks (on Assumed Datum Bridge Deck Elevation = 180.5)

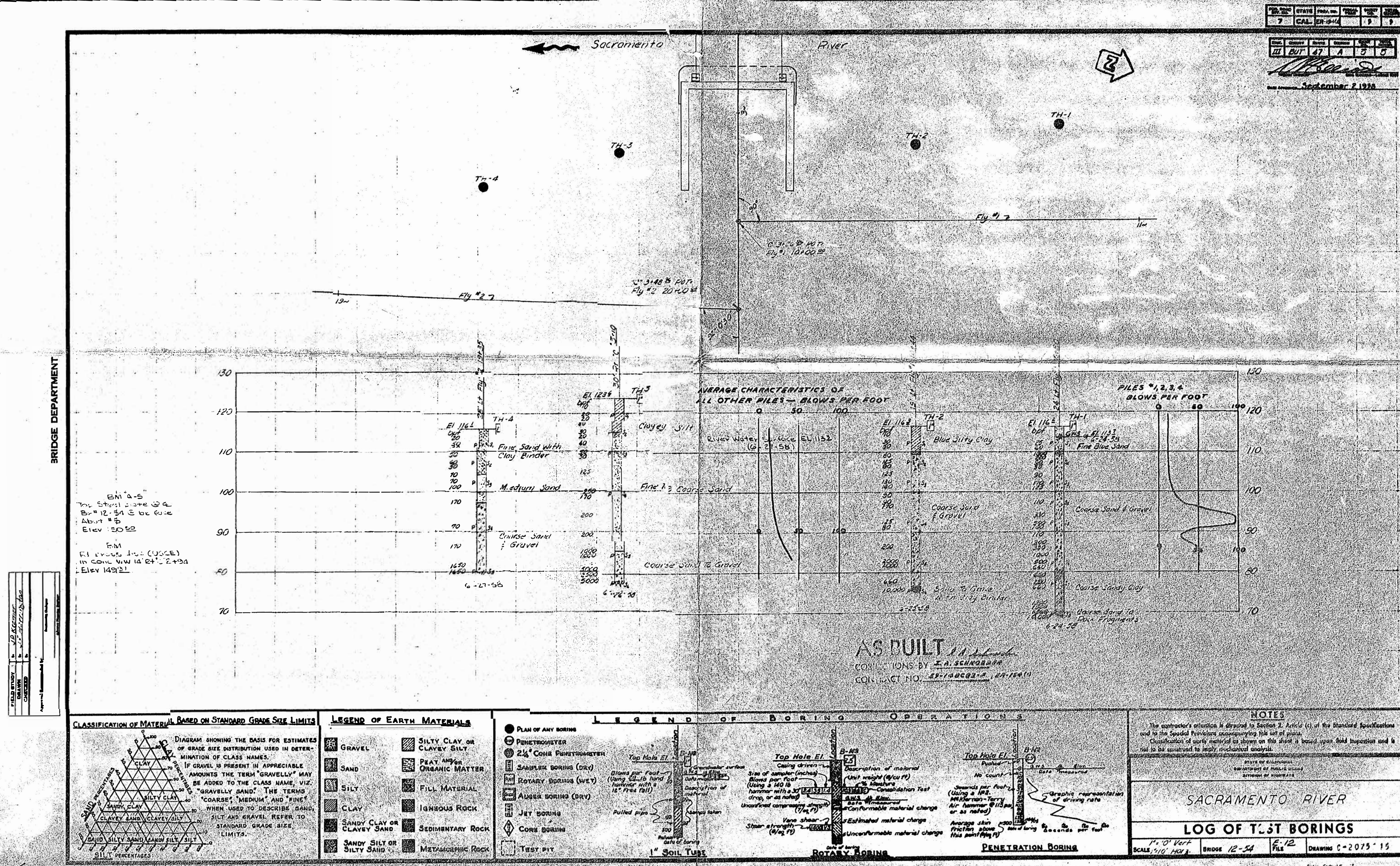
DESIGN SECTION

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

BRIDGE ACROSS SACRAMENTO RIVER
ABUTMENT PROTECTION
MILES WEST OF CHICO IN BUTTE COUNTY

GENERAL PLAN

SCALE As shown



Sacramento
River
TH-1
TH-2
TH-3
TH-4
Fly #1
Fly #2
BRIDGE DEPARTMENT
AVERAGE CHARACTERISTICS OF ALL OTHER PILES — BLOWS PER FOOT
PILES #1, 2, 3, 4 BLOWS PER FOOT
River Water Surface El. 113.2 (6-27-58)
Clayey Silt
Fine Sand with Clay Binder
Medium Sand
Fine & Coarse Sand
Coarse Sand & Gravel
Course Sand To Gravel
Blue Silty Clay
Fine Blue Sand
Coarse Sandy Clay
Coarse Sand To Rock Fragments
Sand To Gravel With Silty Binder
AS BUILT
CORRECTIONS BY I. A. SCHROEDER
CONTRACT NO. 59-14BC03-F, 2R-19(1)
CLASSIFICATION OF MATERIAL BASED ON STANDARD GRADE SIZE LIMITS
DIAGRAM SHOWING THE BASIS FOR ESTIMATES OF GRADE SIZE DISTRIBUTION USED IN DETERMINATION OF CLASS NAMES. IF GRAVEL IS PRESENT IN APPRECIABLE AMOUNTS THE TERM "GRAVELLY" MAY BE ADDED TO THE CLASS NAME, VIZ. "GRAVELLY SAND". THE TERMS "COARSE", "MEDIUM" AND "FINE" WHEN USED TO DESCRIBE SAND, SILT AND GRAVEL REFER TO STANDARD GRADE SIZE LIMITS.
LEGEND OF EARTH MATERIALS
GRAVEL
SAND
SILT
CLAY
SANDY CLAY OR CLAYEY SAND
SANDY SILT OR SILTY SAND
SILTY CLAY OR CLAYEY SILT
PEAT AND/OR ORGANIC MATTER
FILL MATERIAL
IGNEOUS ROCK
SEDIMENTARY ROCK
METAMORPHIC ROCK
LEGEND OF BORING OPERATIONS
PLAN OF ANY BORING
PENETROMETER
2½" CONE PENETROMETER
SAMPLER BORING (DRY)
ROTARY BORING (WET)
AUGER BORING (DRY)
JET BORING
CORE BORING
TEST PIT
1" SOIL TUBE
ROTARY BORING
PENETRATION BORING
NOTES
The contractor's attention is directed to Section 2, Article (c), of the Standard Specifications and to the Special Provisions accompanying this set of plans. Classification of earth material as shown on this sheet is based upon field inspection and is not to be construed to imply mechanical analysis.
SACRAMENTO RIVER
LOG OF TEST BORINGS
September 2, 1958
BRIDGE 12-54

WEST YOST ASSOCIATES
Consulting Engineers

TECHNICAL MEMORANDUM

DATE:	January 25, 2013	Project No.: 436-00-12-17
TO:	Michael Pembroke, Cal Water	
CC:	Peter Bonacich, Cal Water Tom Salzano, Cal Water Vickie Newlin, Butte County	
FROM:	Frank Helmick, R.C.E. #34785 Polly Boissevain, R.C.E. #36164	
REVIEWED BY:	Charles Duncan, R.C.E. #55498	
SUBJECT:	Preliminary Alignment Study	

PURPOSE

This technical memorandum (TM) presents the summary of the Phase 2 Preliminary Alignment Study conducted on the two preferred alternatives recommended in Phase 1 of the California Water Service Company (Cal Water) Chico District's (District) Surface Water Feasibility Study. This TM also includes an evaluation of the hydraulic operation of Alignment 1, a construction cost analysis, and recommendations for the next steps for moving forward with a Phase 3 program for the preferred alternatives.

INTRODUCTION

The purpose of the Phase 1 Feasibility Study was to assess the feasibility of utilizing Butte County's State Water Project (SWP) long-term contract supply as drinking water supply for the District's service area. Phase 1 included the development of the projected surface water delivery quantities; initial screening of sixteen potential water supply conveyance projects; concept-level development of five of the surface water supply conveyance projects; and recommendations for two preferred alternatives for further study.

Based on the results from the Phase 1 concept-level evaluation, the two preferred alternatives selected for further study are:

- Alternative 1: Install a new pipeline along the Abandoned Sacramento Northern Railroad from Thermalito Forebay; and,
- Alternative 2: Install a diversion from the Sacramento River using Radial Collector Wells and pipeline along Highway 32 (will require a surface water exchange between the U.S. Bureau of Reclamation and the Department of Water Resources (DWR)).

These preferred alternatives combine the benefits of ease of implementation/operation as well as lower capital costs. Phase 2 work included additional analysis to further define these two preferred alternatives and identified additional evaluations that may be necessary before selecting the final preferred alternative for potential design and construction. The Phase 2 analysis included evaluating the two pipeline alignments, identifying anticipated construction, permitting and easement acquisition requirements, estimating construction, capital and annual operating costs, and evaluating the potential to operate Alternative 1 by gravity.

Preliminary Alignment Study

The Phase 2 Preliminary Alignment Study included evaluating the pipeline routes associated with the two recommended alternatives. Each alternative was sized to deliver the proposed 20,000 acre-feet per year (AFY) (equivalent to 28 cubic feet per second (cfs), or 18 million gallons per day (mgd) average daily flowrate) of Table A supply to the District for treatment. The location of the proposed water treatment plant, which will be the termination of the raw water pipelines, has not been determined at this time. It is anticipated that the treatment plant would be sited on the south side of Chico for Alternative 1 and west side of Chico for Alternative 2. The preliminary alignment study starts (Alternative 1) and ends (Alternative 2) near the Cal Water Chico District service area boundary.

Alternative 1

Alternative 1 includes a new connection to the DWR Thermalito facilities near Oroville and approximately 18 miles of transmission pipeline to the south side of Chico following the abandoned Sacramento Northern Railroad (SNR) alignment (Figures 1a through 1g). Table 1 provides preliminary details on the recommended infrastructure under Alternative 1. Because of the potential to convey flows to the District by gravity and avoid the need to construct a pumping station, two options were evaluated for connecting to the Thermalito facilities. These include, Option 1, connecting the pipeline to the Thermalito Forebay and Option 2, connecting to the canal between the forebay and afterbay. Elevations at Thermalito Forebay are about 220 feet (the water surface elevation of the forebay) and about 140 feet along the canal that connects the forebay and afterbay. Elevations on the south side of Chico range from about 190 to 200 feet. Table 1 shows the infrastructure proposed for the two options.

Table 1. Alternative 1 – Preliminary Recommended Infrastructure[a,b]

Infrastructure Type	Length/Capacity Recommended: Option 1 (Gravity or Pumped)	Length/Capacity Recommended: Option 2 (Pumped Only)	Unit
Raw Water Intake Structure	28 (18)		cfs (mgd)
Raw Water Booster Pump Station	N/A	28 (18)	cfs (mgd)
Water Treatment Plant	18		mgd
Raw Water Pipeline Diameter	54	42	Inch
Raw Water Pipeline Length	101,000	95,000	Feet

(a) Assumes raw water delivery from the Thermalito facilities to the District service area boundary.
(b) Assumes baseload delivery of Table A supply.

Option 1 could connect to the Thermalito Forebay, adjacent to the DWR pumping plant, and supply water either to a pump station or by gravity to the Alternative 1 pipeline to the District. Option 2 would require a new turnout on the canal between the Thermalito Forebay and Afterbay which would feed water to a new pump station for pumping through the Alternative 1 pipeline to the District. Only Option 1, connection to the Forebay, has sufficient head for pipeline flow by gravity to the District. Preliminary discussions with DWR indicate that connection into the forebay would be far more difficult than connection to the canal, due to the complexity of permits and approvals that would be required. Both connection options are discussed in more detail below.

Field surveys were conducted on July 11 and July 19, 2012. Surveys consisted of driving along accessible areas along the alignment to review conditions for pipeline construction. Figures 1a through 1g show the field notes identifying general alignment comments and the locations of trenchless crossings (highways, existing canals *etc.*). The gravity pipeline (Option 1) would begin near where Hegan Lane crosses the UPRR railway and follows the UPRR alignment until intersecting The Midway (road heading southeast from Chico) and continuing on the same alignment as the pressure pipeline. The pressure pipeline alignment (Option 2) begins at The Midway and Hegan Lane and follows the Chico/Durham Bike Trail adjacent to The Midway for about 2.7 miles before veering away from The Midway and running cross-country along the former SNR alignment. The Alternative 1 alignment would continue along the SNR alignment another 13 miles until it intersects Tres Vias Road (Figures 1f and 1g) where the alignment would continue east about 1.2 miles to the Thermalito Forebay (Option 1) or continue south about 0.5 miles along Wilbur Road to the DWR canal (Option 2)

Based on observations using Google Earth, portions of the SNR alignment between The Midway and Tres Vias Road appear to have been absorbed by the surrounding property owners. Most of the former SNR alignment in this area is now gravel agricultural access roads. There are several locations along the alignment that cross existing rice fields or orchards, and in one location there is a house on the alignment. The rice fields could be crossed following the SNR alignment by taking the crops along the alignment out of production for one season. The rice fields could be replaced in both the permanent and temporary easement areas following construction. If in the future the pipeline needed to be repaired, the rice fields would be temporarily taken out of service to access the pipeline, the repairs made and the crops put back into production. The orchards would require the removal of mature orchard trees. The trees could be replaced in the temporary easement areas following construction, but would not be allowed within the permanent easement. The house located on the alignment would require the pipeline alignment to deviate from the SNR alignment around the structure with a minimum 50 foot or so buffer.

Alternative 2

Alternative 2 includes two new radial collector wells to be constructed adjacent to the Sacramento River, south of Highway 32 and approximately 6 miles of transmission pipeline following Highway 32 to the west side of Chico as shown on Figures 2a through 2f. Table 2 provides preliminary details on the recommended infrastructure under Alternative 2.

The Alternative 2 alignment begins at the Sacramento River and continues east along Highway 32 to the Chico District. A field survey was conducted on July 11, 2012. The field notes identifying general alignment comments and the locations of trenchless crossings (highways, existing canals *etc.*) are included on Figures 2a through 2f.

Table 2. Alternative 2 – Preliminary Recommended Infrastructure[a,b]

Infrastructure Type	Length/Capacity Recommended	Unit
Two (2) Radial Collector Wells	28 (18)	cfs (mgd)
Water Treatment Plant	28 (18)	cfs (mgd)
42-inch diameter Raw Water Pipeline	31,000	Feet

(a) Assumes surface water diversion is located near Hamilton City.
(b) Assumes baseload delivery of surface water supply.

The Alternative 2 preliminary alignment follows Highway 32 along the outside of the right-of-way. Caltrans typically does not permit longitudinal encroachments within its rights-of-way if there are other alternatives, therefore, it is anticipated that Caltrans would not allow the pipe to be placed within the existing Highway 32 right-of-way. This assumption will need to be verified during the next phase of the project. The alignment generally follows existing agricultural access roads or open spaces parallel to the Highway 32 right-of-way. The preliminary alignment crosses Highway 32 in three locations to avoid existing improvements or orchards. As the alignment nears the City of Chico, Highway 32 becomes bounded on both sides with curb, gutter and sidewalk with commercial businesses. If the pipeline alignment continues along Highway 32 from this location, the pipeline will most likely have to be installed within the Highway 32 right-of-way. This decision will be made once the location of the water treatment plant is determined.

Both alternatives have similar construction, permitting, and easement requirements which are discussed below.

Construction

Installation of the pipelines for either alternative will be completed by either open cut or trenchless construction.

Open Cut Construction

Most of the pipeline installation would be by open cut construction where a trench would be excavated and the pipeline placed with a minimum of cover of about 36 inches. Open cut construction can be accommodated for project alignments with conventional pipeline construction equipment. Open cut construction requires a minimum construction zone to install the pipeline. The rule of thumb for pipeline construction is 1 foot of construction zone for each 1 inch of pipe diameter. Therefore, a 42-inch diameter pipeline would require 42 feet of construction zone along the pipeline. This zone width allows the trench spoils and pipeline material to be stockpiled alongside the trench during construction, and provides access for construction equipment. Where this width zone cannot be obtained to protect an existing orchard or because of existing structures along the alignment, the width can be reduced to a minimum of 20 feet. However, the reduced

width requires the spoils to be hauled off-site and pipe and backfill to be hauled back onsite. Therefore, construction becomes much more expensive. The estimated construction cost was prepared anticipating that most of the construction would have a full zone construction width. The full zone width does not need to remain after the construction is complete. Typically a 15 to 20-foot wide permanent pipeline easement would be obtained, centered on the pipeline, and a temporary construction easement for the remaining construction zone width would only be needed for the duration of the construction project. Once the project was completed, the temporary construction zone would be restored to its pre-construction condition.

Trenchless Construction

Trenchless construction will be required where the pipeline crosses Highways 32 and 99 and the existing canals and streams that cannot be crossed by open cut. Trenchless construction in these locations would most likely be completed using bore and jack methods which includes excavating a sending and receiving pit on either side of the crossing, then using an auger to bore under the crossing facility while pushing a steel casing in place. Once the casing is installed, the carrier pipe (water pipe) is jacked through the casing and the casing sealed off.

Permitting

Environmental

The following environmental permits are anticipated to be necessary prior to beginning construction:

- Environmental Impact Report
- California Fish & Game Streambed Alteration Permit
- US Army Corps of Engineers Section 404/401 Permit
- Caltrans – Encroachment Permit for trenchless crossing of Highway 32 and 99 (several locations) and as may be necessary for the east end of Alternative 2 where the pipeline will be within the right-of-way, and as available to serve as a temporary easement for construction of the Alternative 2 pipeline.
- Butte County encroachment permits (right-of-way of various roadways)
- California Department of Industrial Relations, Mining and Tunneling Division - OSHA Underground Classification for tunneling operations (all trenchless crossings larger than 36 inches in diameter)
- Canal owner encroachment permits (need to identify name and owner of canals to be crossed)
- Department of Water Resources – Approval to connect to the Thermalito facilities for Alternative 1.

This list of permits does not include the permits that may be required for the construction of the radial collector wells along the Sacramento River, or for the connection to Thermalito Forebay. During the next phase of the project, the permit requirements will need to be evaluated in more detail and confirmed.

Temporary and Permanent Easement Requirements

Permanent easements will be required for the pipelines that are not within existing road rights-of-way. Typically, for this size pipe, permanent easement widths would be 15 to 20 feet wide, centered on the pipe. Temporary easements parallel to the permanent easements are needed to construct the pipeline. For this analysis, a total easement width of 1 foot per diameter inch of pipe was used, consisting of a 20-foot wide permanent easement and the remainder as temporary easement.

Alternative 1

It is assumed that the former SNR easement has been relinquished to the adjacent property owners and the permanent and temporary easements would have to be purchased from the adjacent property owners. The permanent easement for the Alternative 1 alignment will generally follow the centerline of the former SNR alignment, except be centered on the existing agricultural access roads. There are several locations where permanent easements within existing orchards will need to be obtained. The temporary easements will be obtained on the side of the permanent easement that minimizes the impacts to the adjacent properties.

Alternative 2

One side of the permanent easement for Alternative 2 will be along the Highway 32 right-of-way, requiring the temporary easement to either be completely on the side opposite of Highway 32 or obtain approval from Caltrans to allow a portion of the Highway 32 right-of-way for use on a temporary basis.

A majority of the Alternative 2 alignment has existing orchards on either side of the right-of-way which will be expensive to obtain. The tradeoff is that the construction costs will go up because of the limitation of the area to install the pipeline. For this analysis, it was assumed that existing orchard land within the proposed permanent and temporary easements would be taken.

Alternative 1 Connection to Thermalito Facilities

The Thermalito Forebay receives water from Lake Oroville via the Thermalito Power Canal. The Thermalito Pumping-Generating Plant, located at the forebay discharges water to the Thermalito Afterbay via a 9,100-foot canal connecting the plant to the afterbay. As described earlier, there are two options for connecting Alternative 1 to the Thermalito facilities, Option 1, connect to forebay through the concrete wing wall adjacent to the Pumping-Generating Plant, and Option 2, connect to the canal between the forebay and afterbay. A planning level hydraulic study was conducted for each option to evaluate the pipeline sizing for delivery requirements (pumping or gravity) for delivering surface water from the Thermalito facilities to the District. Both options were reviewed with DWR Operations and Maintenance Division to obtain their initial input.

Option 1 – Connection to the Thermalito Forebay

Option 1 includes core drilling a hole in the existing concrete wing wall adjacent to the DWR Pumping-Generation Plant, then installing a screened intake on the forebay side of the wing wall and routing the discharge pipe through the hole in the wing wall. Figure 3 shows a plan view of the connection point. Figure 4 show a cross section of the proposed intake. Water levels at the

Forebay are estimated to vary between 222 and 224 feet. The ground surface elevation near the location proposed for the water treatment plant is about 191 feet.

A hydraulic study for this option was performed and considered three potential pipeline sizes: 42-inch, 48-inch, and 54-inch. Table 3 summarizes the assumptions made for the hydraulic evaluation. Figure 5 shows a plot of the hydraulic grade lines (HGL's) for the pipeline diameters considered.

Table 3. Hydraulic Assumptions for the Connection at Thermalito Forebay

Parameter	Value
Water Surface Elevation At Thermalito Forebay, ft msl	220
Elevation at City of Chico, ft msl[a]	191
Flowrate, mgd	18
Alignment length, ft	101,000
Hazen Williams C-Factor	140
Minor Losses, ft (percent of Friction Losses)	5%
Pump Efficiency	75%

(a) Calculations assume water would be pumped to a new water treatment plant, located on the south side of Chico near the intersection of Hagan and UPRR.

Results of the hydraulic analysis indicate that both the 42-inch and the 48-inch diameter options would require the construction of a pump station. The 54-inch diameter pipeline is the minimum diameter pipeline required for gravity conveyance.

Table 4 summarizes required pumping head and annual energy requirements if pumping at 18 mgd. Annual energy requirements are calculated assuming a maximum Table A contract delivery amount of 20,000 AFY, and a long-term average annual delivery of 11,700 AFY, based on the long-term SWP delivery reliability of approximately 59 percent of Table A amounts, estimated by DWR in its 2011 State Water Project Delivery Reliability Report.

Table 4. Required Pump Discharge Head and Annual Energy Requirements

Diameter, in	Required Pump Head, ft	Installed Pump Station Capacity, kw	Annual Energy Requirement, kwh[a]
42	28	90	460,000
48	1	10	16,000
54	-12[b]	-	-

(a) Annual energy requirements based on the estimated annual delivery of 11,700 AFY, which is the estimated long-term SWP delivery reliability for a total Table A amount of 20,000 AFY.
(b) Negative pumping head equates to gravity flow.

The benefit of this option is the ability to deliver water to the District by gravity. The disadvantage of this option is the lengthy approval process necessary to obtain DWR approval and the chance that DWR will deny the application. In DWR's initial review of this concept, it

was noted that engineering feasibility studies would be required for alteration of the existing structure, including seismic and structural analysis. Approval would also be required from the Federal Energy Regulatory Commission (FERC), since the facility is a licensed power facility, and from the State's Division of Safety of Dams. Impacts to DWR's operation of Thermalito facilities and re-licensing efforts would also need to be considered as well.

Option 2 - Connection to the Canal

Option 2 would require the construction of a turnout on the DWR canal and a pump station to deliver water to the District. Figure 6 shows the conceptual turnout on the canal. Because the canal is considerably lower in elevation than the forebay, this option would require a pump station.

The hydraulic study for this option considered 4 potential pipeline sizes: 42-inch, 48-inch, 54-inch and 60-inch. Table 5 summarizes the assumptions made for the hydraulic evaluation. For the analysis it was assumed that the water surface elevation in the canal between the Forebay and the Afterbay is 130 ft.

Table 5. Hydraulic Assumptions for the Turnout at the Canal between Thermalito Forebay and Afterbay

Parameter	Value
Water Surface Elevation in the Canal, ft msl	130
Elevation at City of Chico, ft msl[a]	203
Flowrate, mgd	18
Alignment length, ft	95,000
Hazen Williams C-Factor	140
Minor Losses, ft (percent of Friction Losses)	5%
Pump Efficiency	75%

(a) Calculations assume water would be pumped to a new water treatment plant, located on the south side of Chico near the intersection of The Midway and Hagan.

For all pipeline diameters, a pump station would be required to convey water from the canal to Chico District. Table 6 summarizes the results of the analysis and provides the required pump lift for each pipe diameter.

Table 6. Required Pump Discharge Head and Annual Energy Requirement

Diameter, in	Required Pump Head, ft	Installed Pump Station Capacity, kw	Annual Energy Requirement, million kwh[a]
42	118	370	1.92
48	91	290	1.50
54	78	250	1.27
60	71	230	1.16

(a) Annual energy requirements based on the estimated annual delivery of 11,700 AFY, which is the estimated long-term SWP delivery reliability for a total Table A amount of 20,000 AFY.

A rough cost analysis comparing the cost of larger diameter pipeline with the smaller pump station sizing and annual energy requirements indicates that upsizing the pipeline is probably not warranted due to the length of the pipeline required and costs of the additional private temporary easements.

This option is less desirable because it would require the construction of a pump station, and there would be an ongoing energy cost to pump water to the District due to the lower water elevation in the canal. The benefit of this option is that DWR has many similar turnouts on their facilities, and approval for this option would be much easier than for the Option 1 connection. In preliminary review of this option with DWR, they indicated that this would be similar to other DWR facilities (*e.g.* the South Bay Aqueduct), where turnouts are routinely installed for State Water Contractors.

COST ANALYSIS

A cost evaluation was conducted to compare the estimated construction costs of Alternative 1 and Alternative 2. For Alternative 1, two options are considered: gravity pipeline at 60-inch diameter and pressure pipeline at 42-inch diameter.

The cost estimate for the pipe construction was based on a base unit cost of $8.00 per diameter inch of pipe. The base pipeline cost was adjusted depending upon the area where the construction is to occur (construction category). Permanent and temporary easement costs were also estimated for the construction area. Pipeline cost factors and the permanent and temporary easement costs associated with each construction category is shown in Table 7.

Table 7. Construction Area/Cost Factors

Construction Category	Pipeline Cost Factor	Permanent Easement (per acre)	Temporary Easement (per acre)
Aggregate Road	1.10	$10,000	$1,000
Bike Path	2.00	$0	$0
Commercial	1.25	$10,000	$1,000
Crop	1.00	$10,000	$5,000
Open	1.00	$10,000	$1,000
Orchard	1.15	$20,000	$20,000
Road	1.50	$0	$0
Trenchless	4.00	$10,000	$0

Permanent easement costs were based on 20-foot wide easement centered on the center of the pipeline. Temporary easement costs were based on the total easement required (1 foot per diameter-inch) minus the permanent easement and the construction category of the area adjacent to the permanent easement.

The pump station costs were developed from cost curves. Radial well costs were developed from estimates developed for a Llano Seco Ranch study.

A summary of the estimated construction, capital and annual costs for each alternative is shown in Table 8. The annual cost summary indicates that for Alternative 1, the additional cost to upsize the pipeline for gravity feed is more than the annual energy cost savings.

Table 8. Estimated Construction, Capital and Annual Costs (million $)[a]

Description	Alternative 1 - Option 1 Gravity Pipeline from Thermalito Facilities to Chico	Alternative 1 – Option 2 Pressure Pipeline from Thermalito Facilities to Chico	Alternative 2 – Radial Wells and Pipeline from Sacramento River to Chico
Construction and Capital Costs			
Pipeline	$51.8	$39.5	$10.4
Permanent Easements	$0.5	$0.4	$0.1
Temporary Easements	$0.6	$0.3	$0.05
Intake Structure/ Pump Station	$0	$6.8	$7.4
Total Construction Cost	$52.9	$47.0	$18.0
Total Capital Cost	$82.5	$73.3	$28.1
Annual Costs			
Annual Revenue Requirement[b]	$10.73	$9.53	$3.65
Annual O&M Cost[c]	$2.65	$2.35	$0.90
Annual Energy Costs[d]	$0.00	$0.23	$0.11
Total Annual Costs	$13.37	$12.11	$4.67

(a) Costs computed in December 2012 (20-Cities ENR CCI = 9412). Capital costs include 20% construction cost contingency and 30% implementation multiplier for design, planning, construction services, and administration. Total implementation multiplier is 156% ((Base Construction Cost + 20%) x 130%).
(b) Annual revenue requirement estimated at 13 percent, based on Cal Water planning estimates.
(c) Annual O&M costs assumed to be 5 percent of construction costs.
(d) Annual energy costs estimated at $0.12/kwh.

CONCLUSIONS

Two alignments were evaluated based on recommendations from Phase 1 of this study. Alternative 1: Pipeline from Thermalito Facilities to South Chico, and Alternative 2: Pipeline from Radial Well Collectors on the Sacramento River to West Chico. From a construction perspective, both alternative alignments can be constructed along the alignments outlined in this TM. The capital costs for Alternative 1 are about 260 percent of Alternative 2 costs, due to the significantly longer pipeline required to convey water to Chico.

The analysis also evaluated connection options at the Thermalito facilities. Although a gravity pipeline would be possible if the tie-in could be made at the Thermalito Forebay, implementation would be significantly more difficult, due to the number of regulatory reviews that would be required. Additionally, the cost savings of not pumping do not appear to be significant enough to offset the increased pipeline cost required for a gravity pipeline.

The next phase of the project should include additional evaluation of the each alignment including:

- Identifying the location(s) of the water treatment plant to finalize connection points into the Chico District system.
- Discussing the project with Caltrans and the suitability of obtaining a parallel permanent easement or use of the Highway 32 right-of-way for temporary easement, and the options for continuing further east on Highway 32 from where the alignment study ended (Alternative 2).
- Conducting a preliminary easement acquisition analysis to further refine permanent and temporary easement costs
- Continuing discussions with the Department of Water Resources regarding the connection to the Thermalito facilities.

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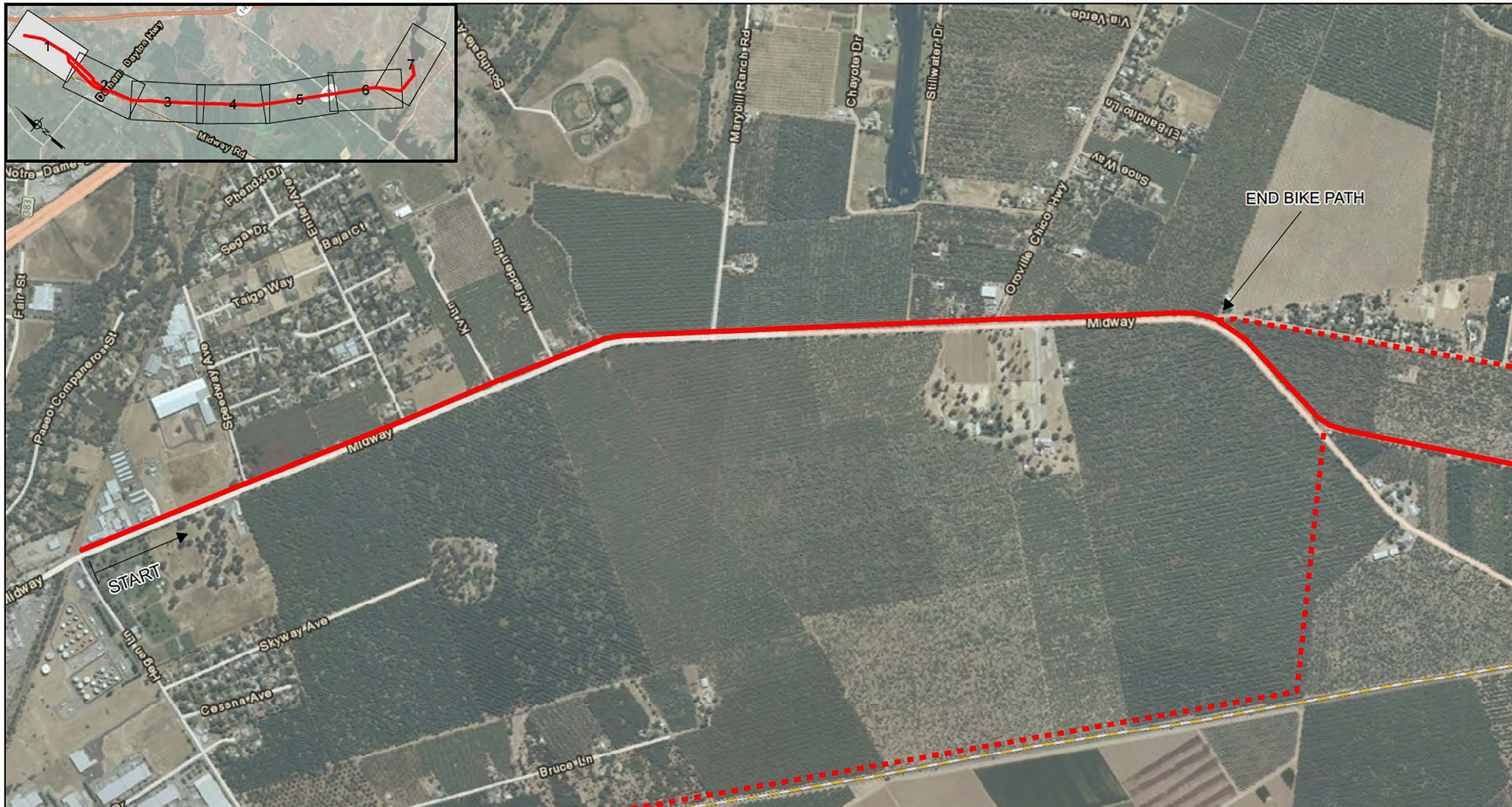

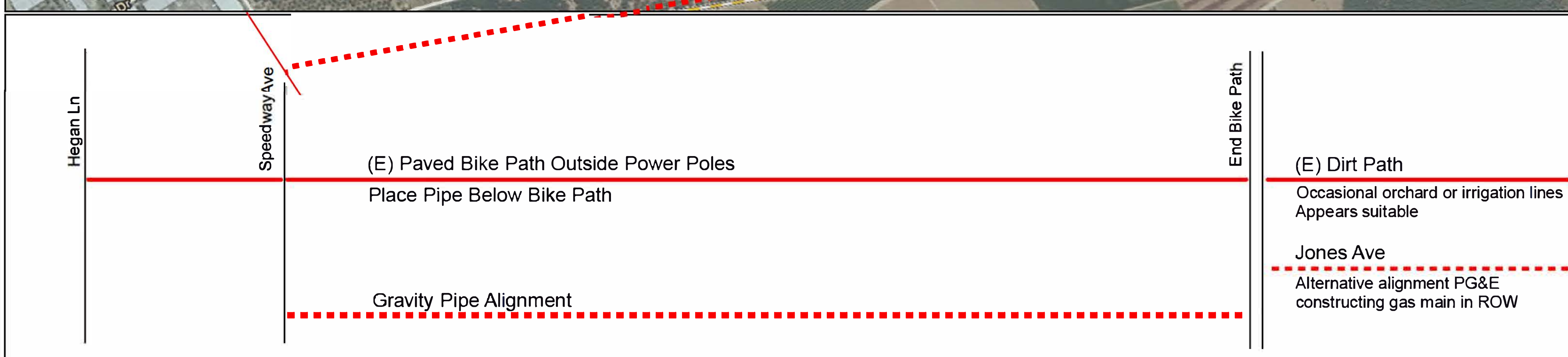

FIGURE 1a

California Water Service Company
Preliminary Alignment Study

PRELIMINARY FIELD NOTES - ALIGNMENT 1, SECTION 1

LEGEND

(solid red line)	Alignment #1
(dotted red line)	Alternative Alignment
(E)	Existing
Agg.	Aggregate

Notes
1. Preliminary alignment study completed on July 12 and July 19, 2012.

0 600 1,200
Scale in Feet

WEST YOST ASSOCIATES
Consulting Engineers

FIGURE 1b

California Water Service Company
Preliminary Alignment Study

PRELIMINARY FIELD NOTES - ALIGNMENT 1, SECTION 2

LEGEND

- Alignment #1
- Alternative Alignment
- (E) Existing
- Agg. Aggregate

Notes
1. Preliminary alignment study completed on July 12 and July 19, 2012.

Durham / Dayton Hwy

(E) Dirt Path

Occasional orchard or irrigation lines
Appears suitable

Parallel to UPRR
May be too close
Limited room for construction

Commercial Driveway

Unclear (no access)

Jones Ave

Alternative alignment PG&E constructing gas main in ROW

0 600 1,200
Scale in Feet

CALIFORNIA WATER SERVICE CO

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Consulting Engineers

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FIGURE 1c

California Water Service Company
Preliminary Alignment Study

PRELIMINARY FIELD NOTES - ALIGNMENT 1, SECTION 3

LEGEND

Alignment #1
(E) Existing
Agg. Aggregate

Notes
1. Preliminary alignment study completed on July 12 and July 19, 2012.

0 600 1,200
Scale in Feet

WEST YOST ASSOCIATES
Consulting Engineers

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FIGURE 1d

California Water Service Company
Preliminary Alignment Study

PRELIMINARY FIELD NOTES - ALIGNMENT 1, SECTION 4

LEGEND

(red line)	Alignment #1
(E)	Existing
Agg.	Aggregate

Notes
1. Preliminary alignment study completed on July 12 and July 19, 2012.

0 600 1,200
Scale in Feet

WEST YOST ASSOCIATES
Consulting Engineers

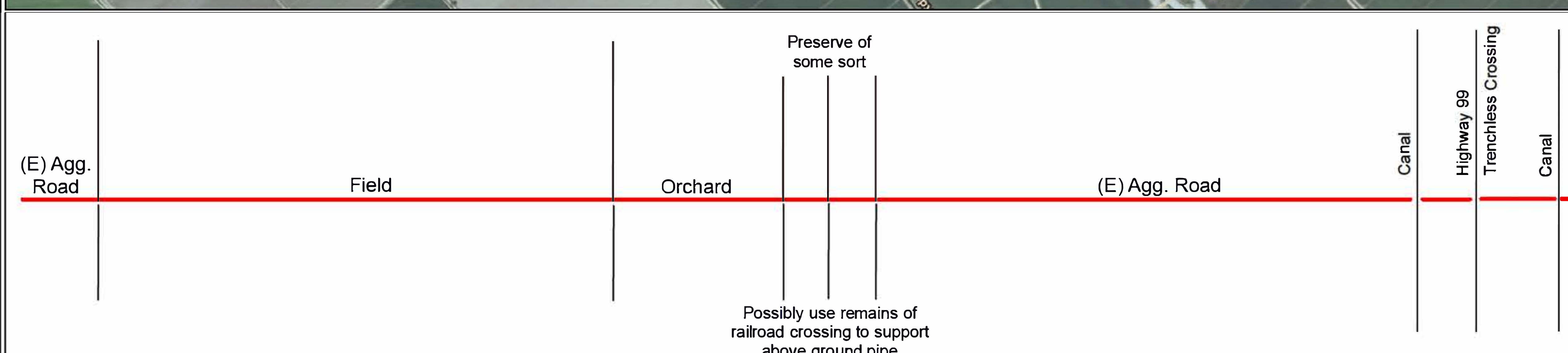

FIGURE 1e

California Water Service Company
Preliminary Alignment Study

PRELIMINARY
FIELD NOTES -
ALIGNMENT 1,
SECTION 5

LEGEND

Alignment #1
(E) Existing
Agg. Aggregate

Notes
1. Preliminary alignment study completed on July 12 and July 19, 2012.

0 600 1,200
Scale in Feet

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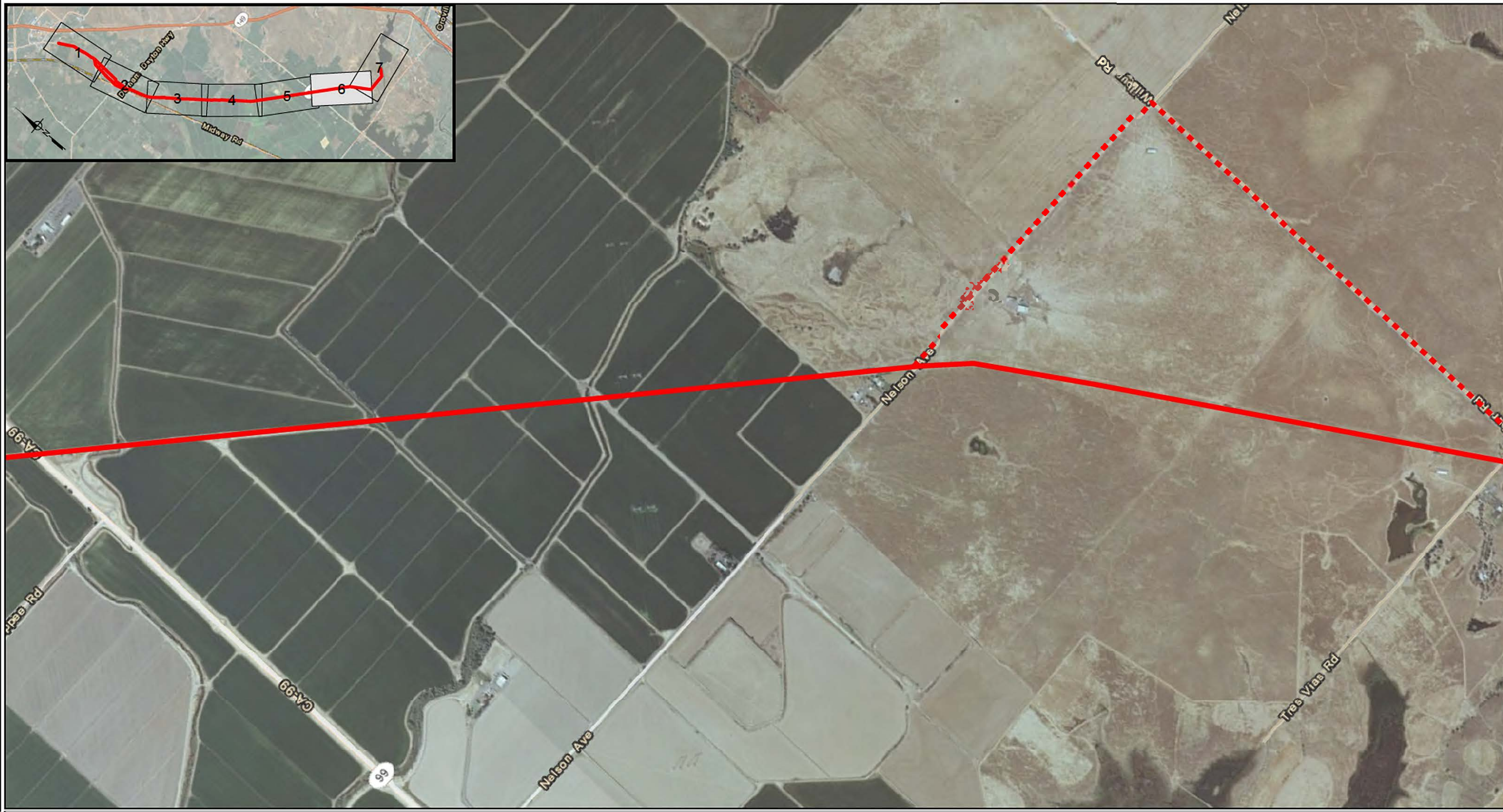

Highway 99

Canal

(E) Agg. Road

Canal

Canal

Have to negotiate with Farmer
Consider not installing access road over pipe

North on Wilber and west on Nelson is an acceptable alternative to crossing parcel

FIGURE 1f

California Water Service Company
Preliminary Alignment Study

PRELIMINARY FIELD NOTES - ALIGNMENT 1, SECTION 6

LEGEND

Alignment #1

Alt Alignment 1

(E) Existing

Agg. Aggregate

Notes

1. Preliminary alignment study completed on July 12 and July 19, 2012.

0 600 1,200

Scale in Feet

WEST YOST ASSOCIATES
Consulting Engineers

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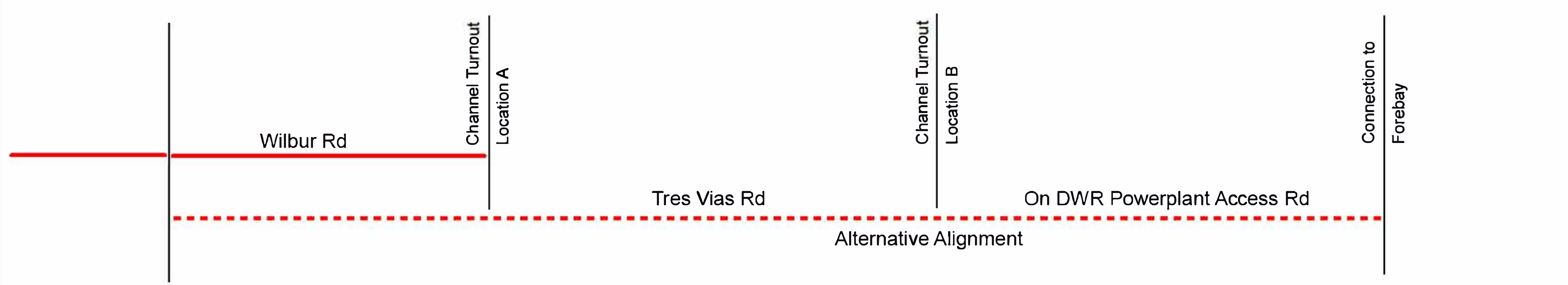

FIGURE 1g

California Water Service Company
Preliminary Alignment Study

PRELIMINARY FIELD NOTES - ALIGNMENT 1, SECTION 7

LEGEND

Alignment #1
Alternative Alignment
(E) Existing
Agg. Aggregate

Notes
1. Preliminary alignment study completed on July 12 and July 19, 2012.

0 600 1,200
Scale in Feet

WEST YOST ASSOCIATES
Consulting Engineers

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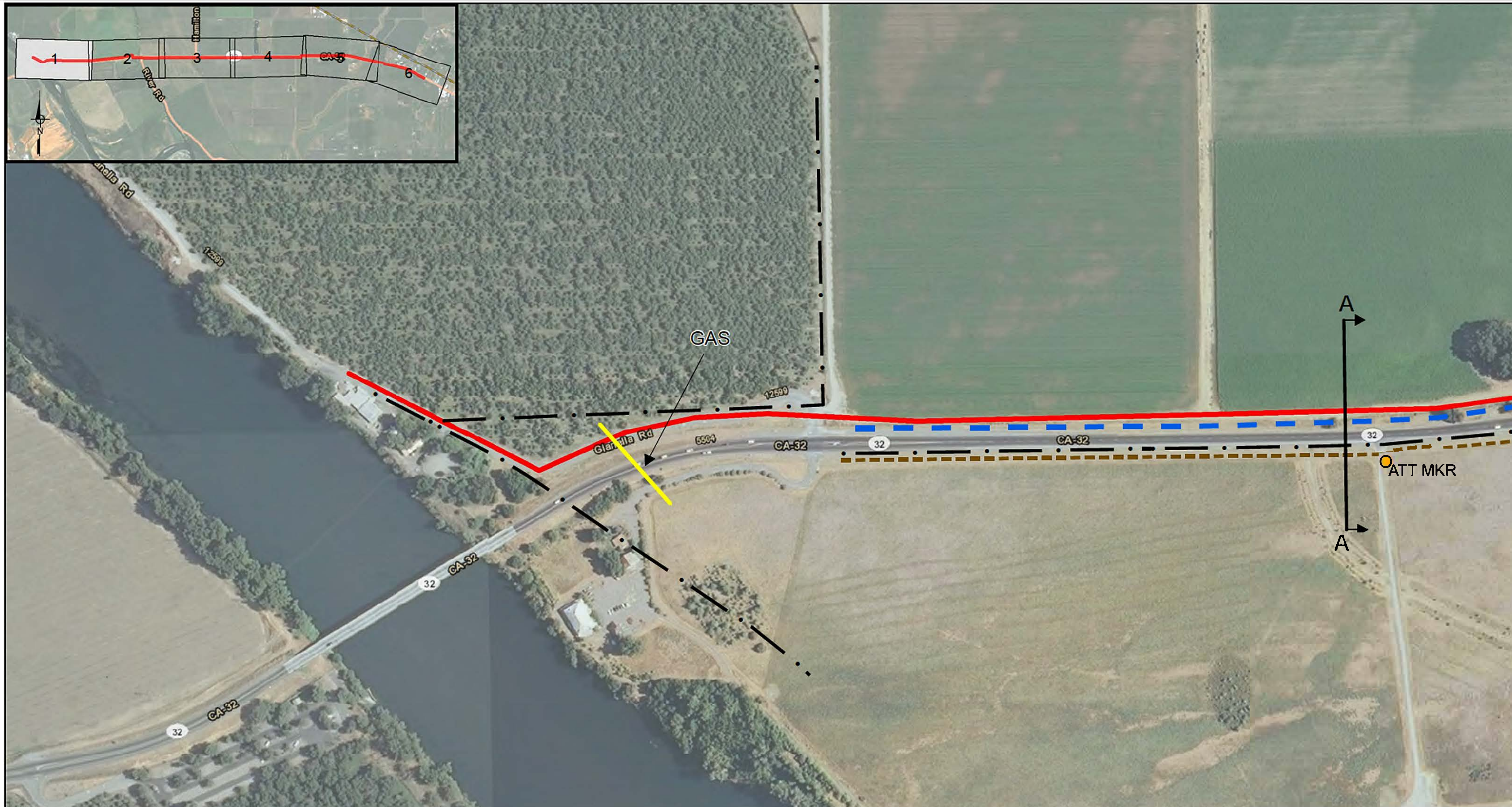


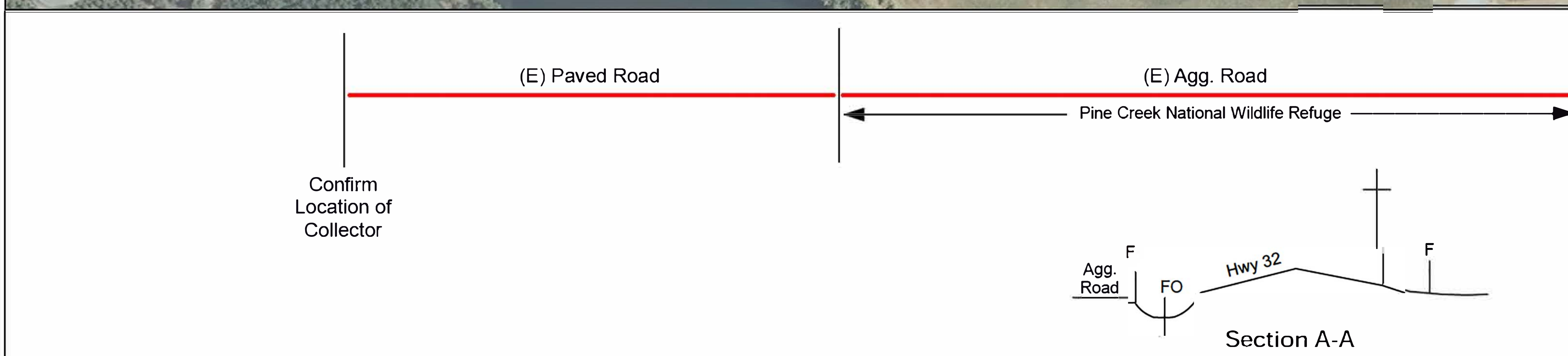


FIGURE 2a

California Water Service Company
Preliminary Alignment Study

PRELIMINARY FIELD NOTES - ALIGNMENT 2, SECTION 1

LEGEND

- Highway 32 Pipeline Alignment
- Overhead
- Fiber Optic
- Post and Cable
- GAS

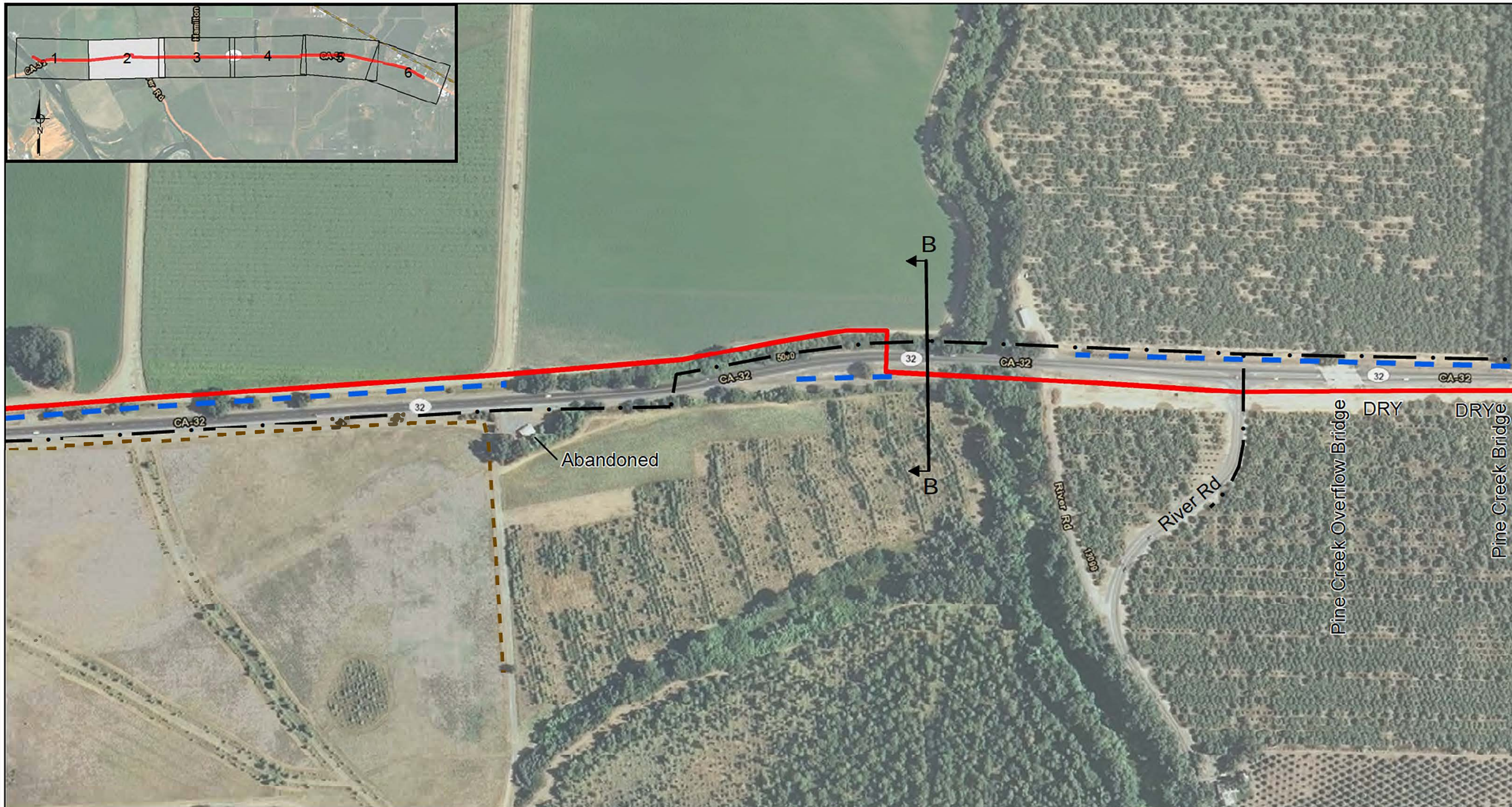
(E) Existing
Agg. Aggregate

Notes
1. Preliminary alignment study completed on July 12, 2012.

N

0 200 400
Scale in Feet

WEST YOST ASSOCIATES
Consulting Engineers



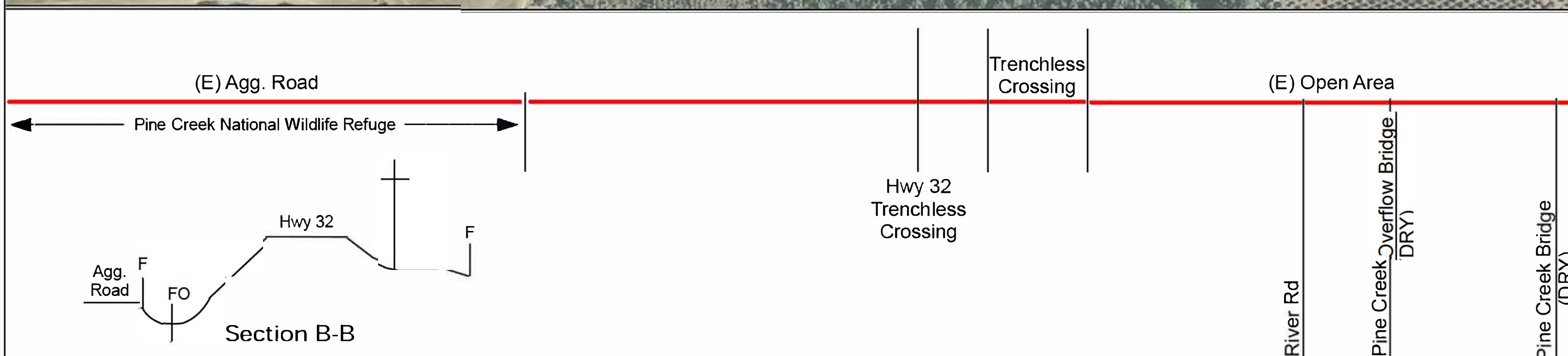


FIGURE 2b

California Water Service Company
Preliminary Alignment Study

PRELIMINARY FIELD NOTES - ALIGNMENT 2, SECTION 2

LEGEND

	Highway 32 Pipeline Alignment
	Overhead
	Fiber Optic
	Post and Cable
(E)	Existing
Agg.	Aggregate

Notes
1. Preliminary alignment study completed on July 12, 2012.

0 200 400
Scale in Feet

WEST YOST ASSOCIATES
Consulting Engineers

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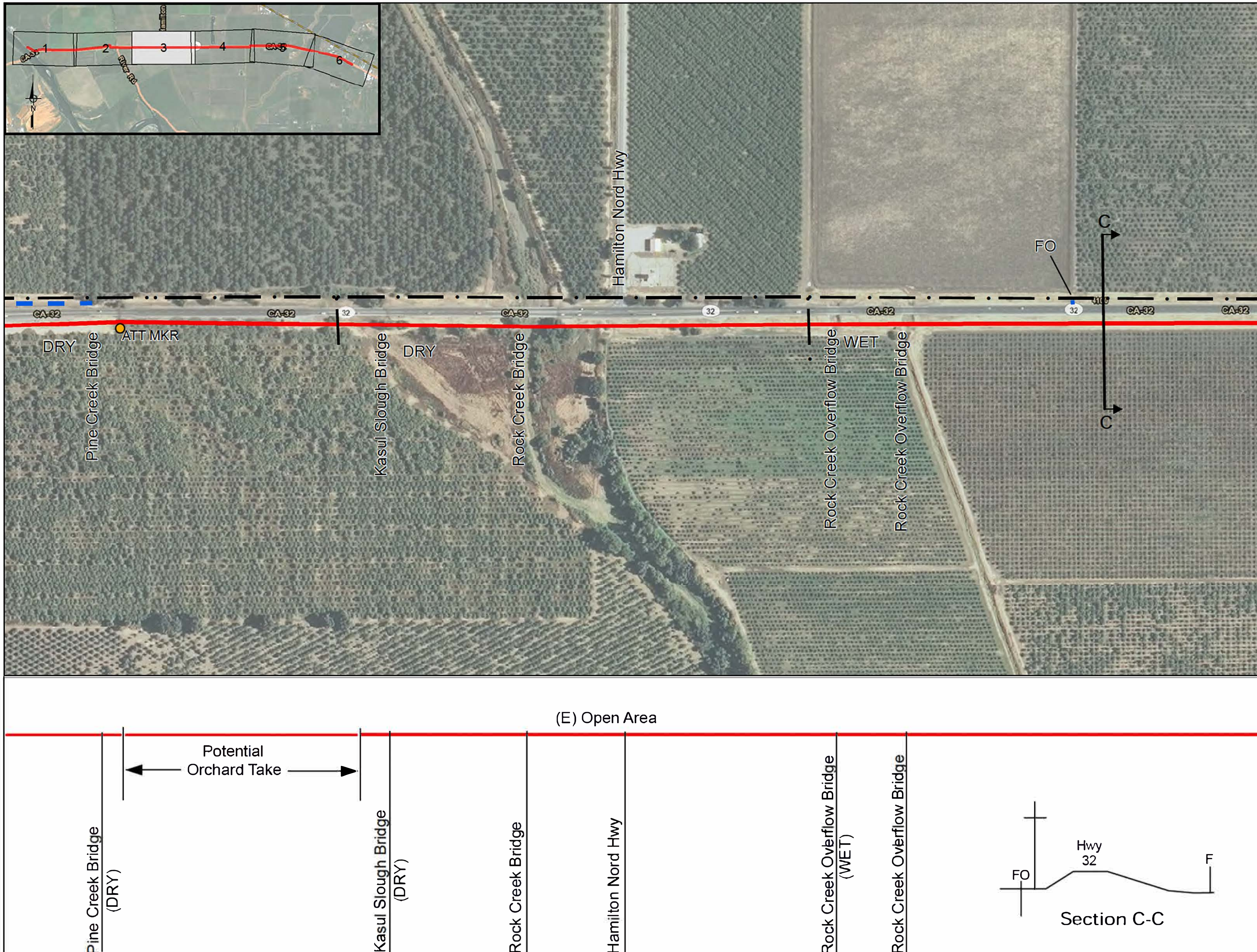


FIGURE 2c

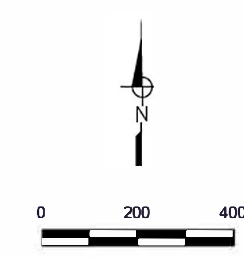
California Water Service Company
Preliminary Alignment Study

PRELIMINARY FIELD NOTES - ALIGNMENT 2, SECTION 3

LEGEND

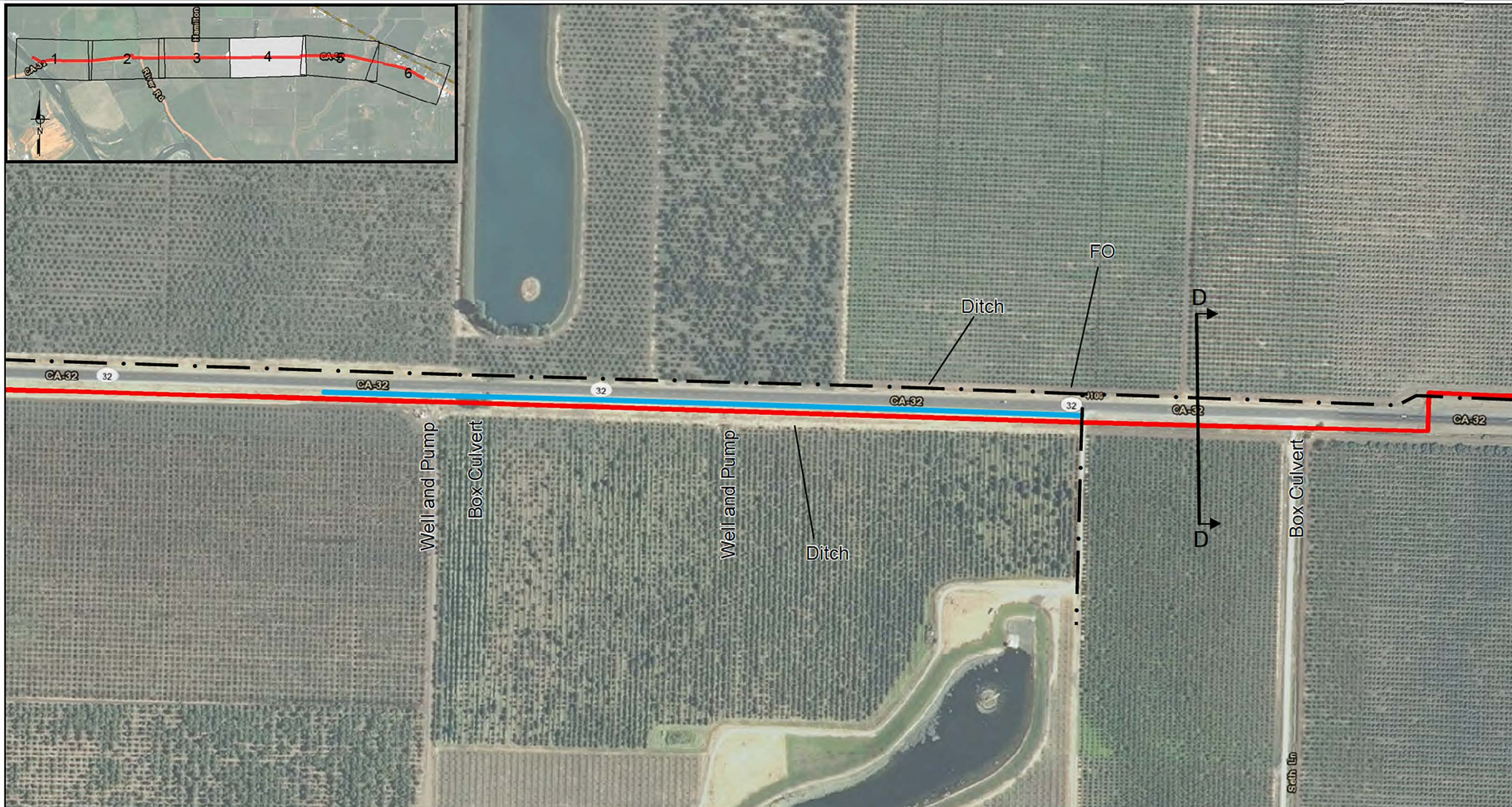
	Highway 32 Pipeline Alignment
	Overhead
	Fiber Optic
(E)	Existing
Agg.	Aggregate

Notes
1. Preliminary alignment study completed on July 12, 2012.



WEST YOST ASSOCIATES
Consulting Engineers

N:\Clients\436 California Water Service Company\00-12-17 FS Surface Phase 2\GIS\Figures\Align-2d smb (GIS10 only).mxd



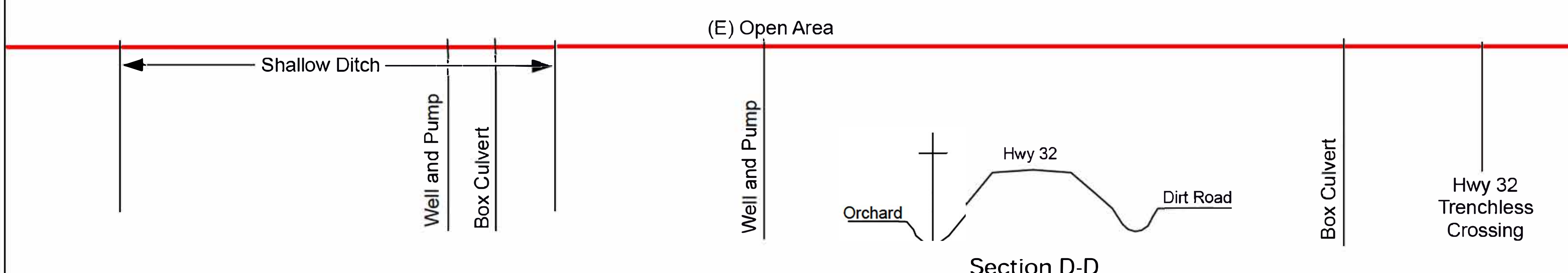


FIGURE 2d

California Water Service Company
Preliminary Alignment Study

PRELIMINARY FIELD NOTES - ALIGNMENT 2, SECTION 4

LEGEND

(red line)	Highway 32 Pipeline Alignment
(dash-dot line)	Overhead
(blue line)	Underground Telephone
(E)	Existing
Agg.	Aggregate

Notes
1. Preliminary alignment study completed on July 12, 2012.

N

0 200 400
Scale in Feet

WEST YOST ASSOCIATES
Consulting Engineers

N:\Clients\436 California Water Service Company\00-12-17 FS Surface Phase 2\GIS\Figures\Align-2e smb (GIS10 only) mxd

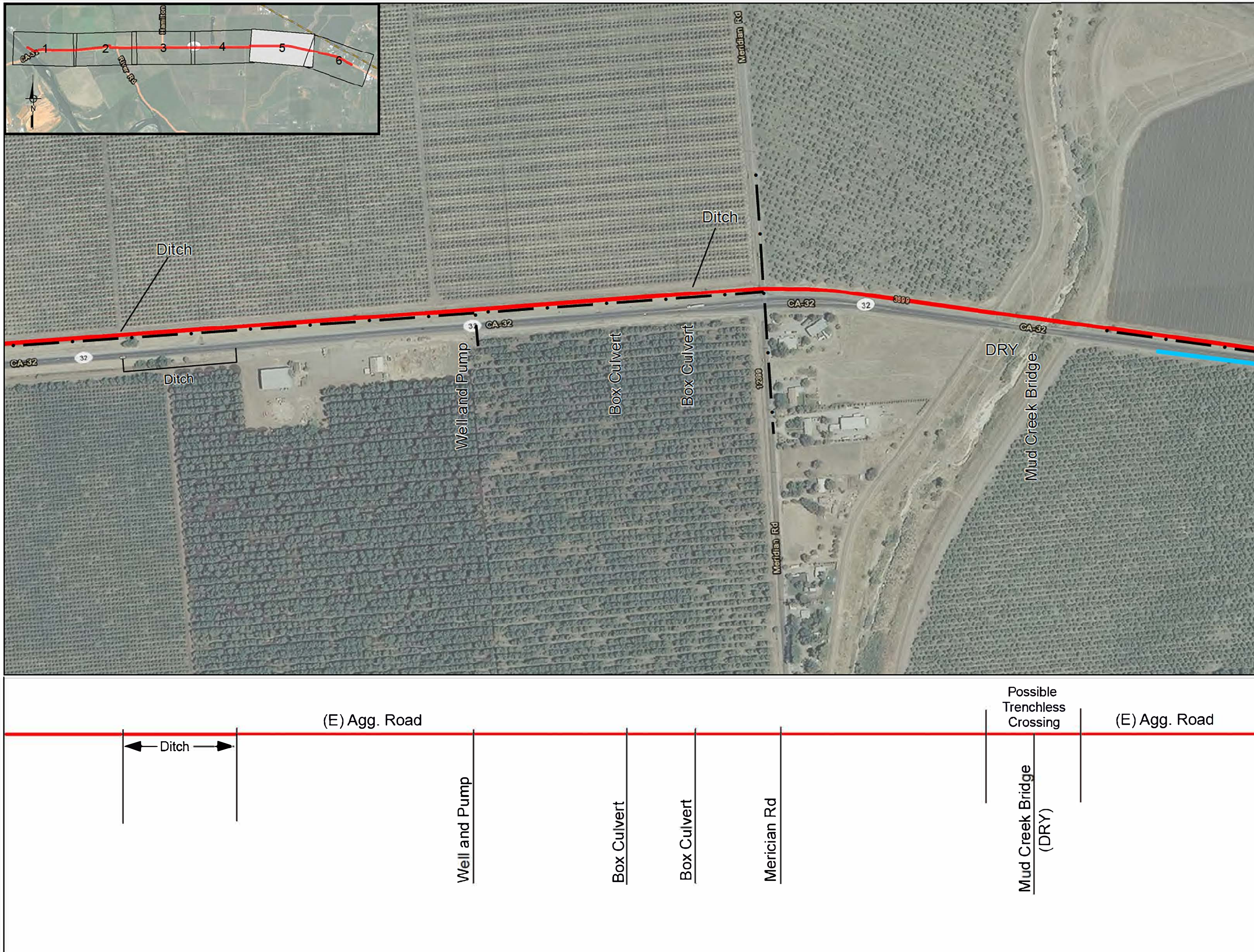


FIGURE 2e

California Water Service Company
Preliminary Alignment Study

PRELIMINARY FIELD NOTES - ALIGNMENT 2, SECTION 5

LEGEND

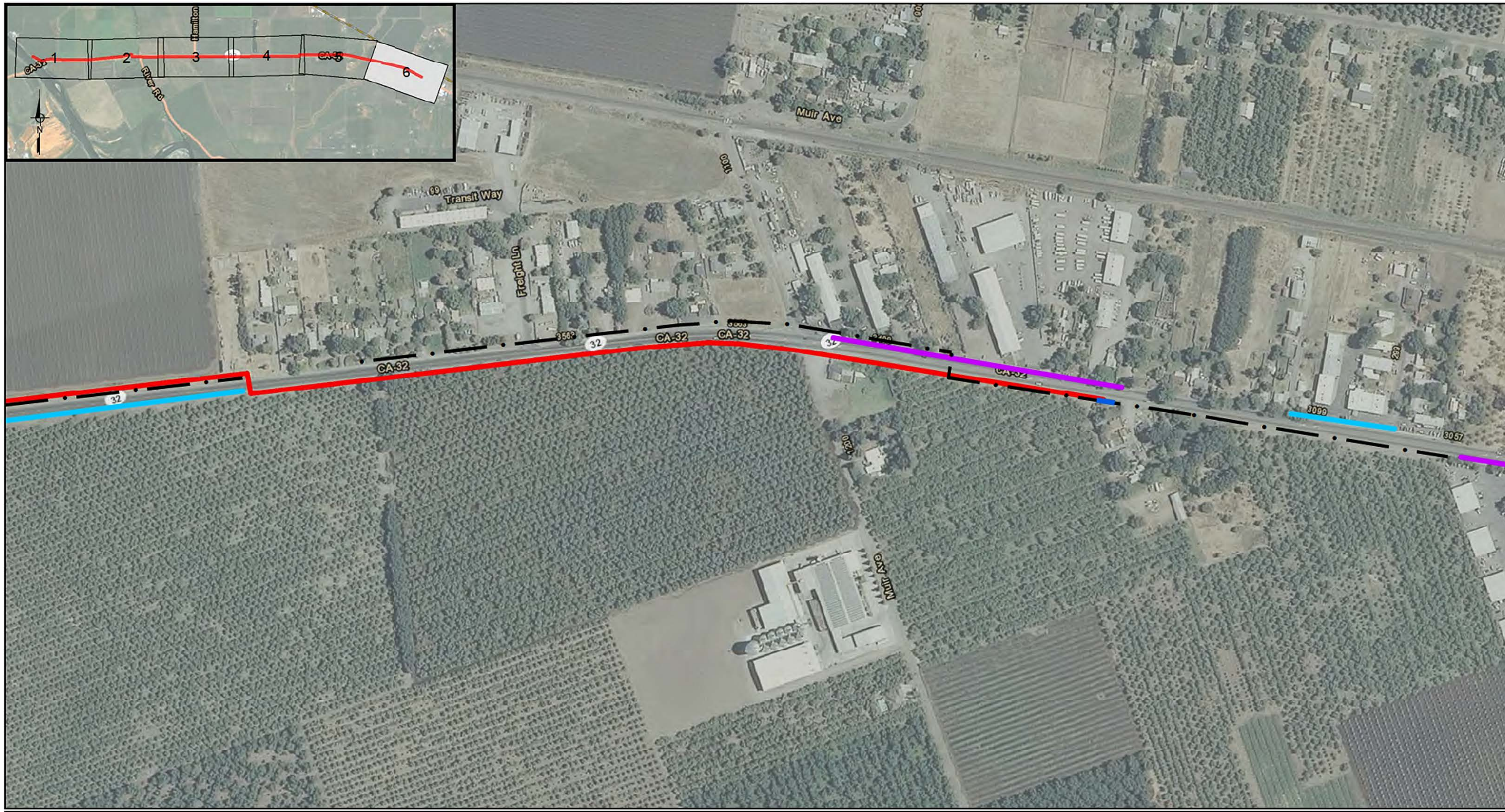
Highway 32 Pipeline Alignment
Overhead
Underground Telephone
(E) Existing
Agg. Aggregate

Notes
1. Preliminary alignment study completed on July 12, 2012.

0 200 400
Scale in Feet

WEST YOST ASSOCIATES
Consulting Engineers

N:\Clients\436 California Water Service Company\00-12-17 FS Surface Phase 2\GIS\Figures\Align-2f smb (GIS10 only).mxd



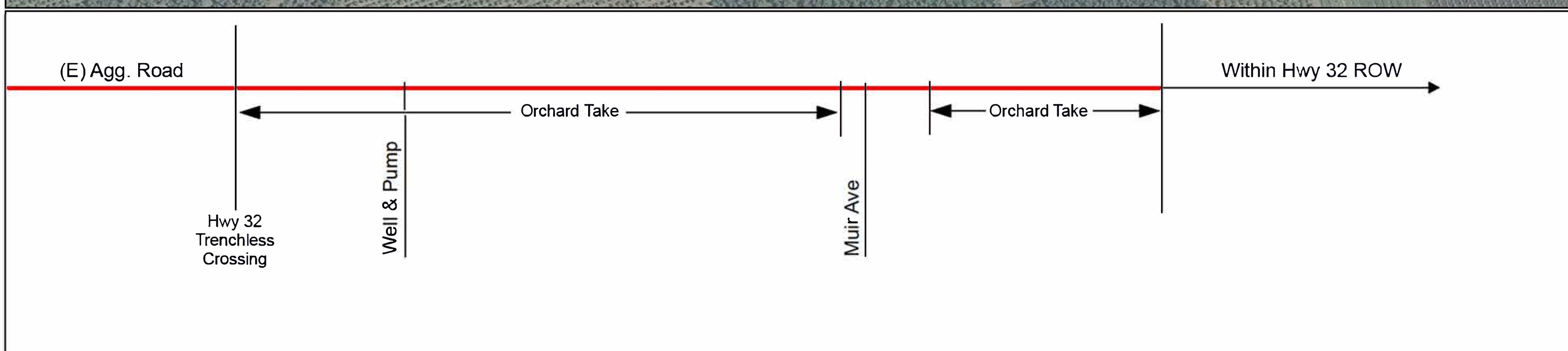


FIGURE 2f

California Water Service Company
Preliminary Alignment Study

PRELIMINARY FIELD NOTES - ALIGNMENT 2, SECTION 6

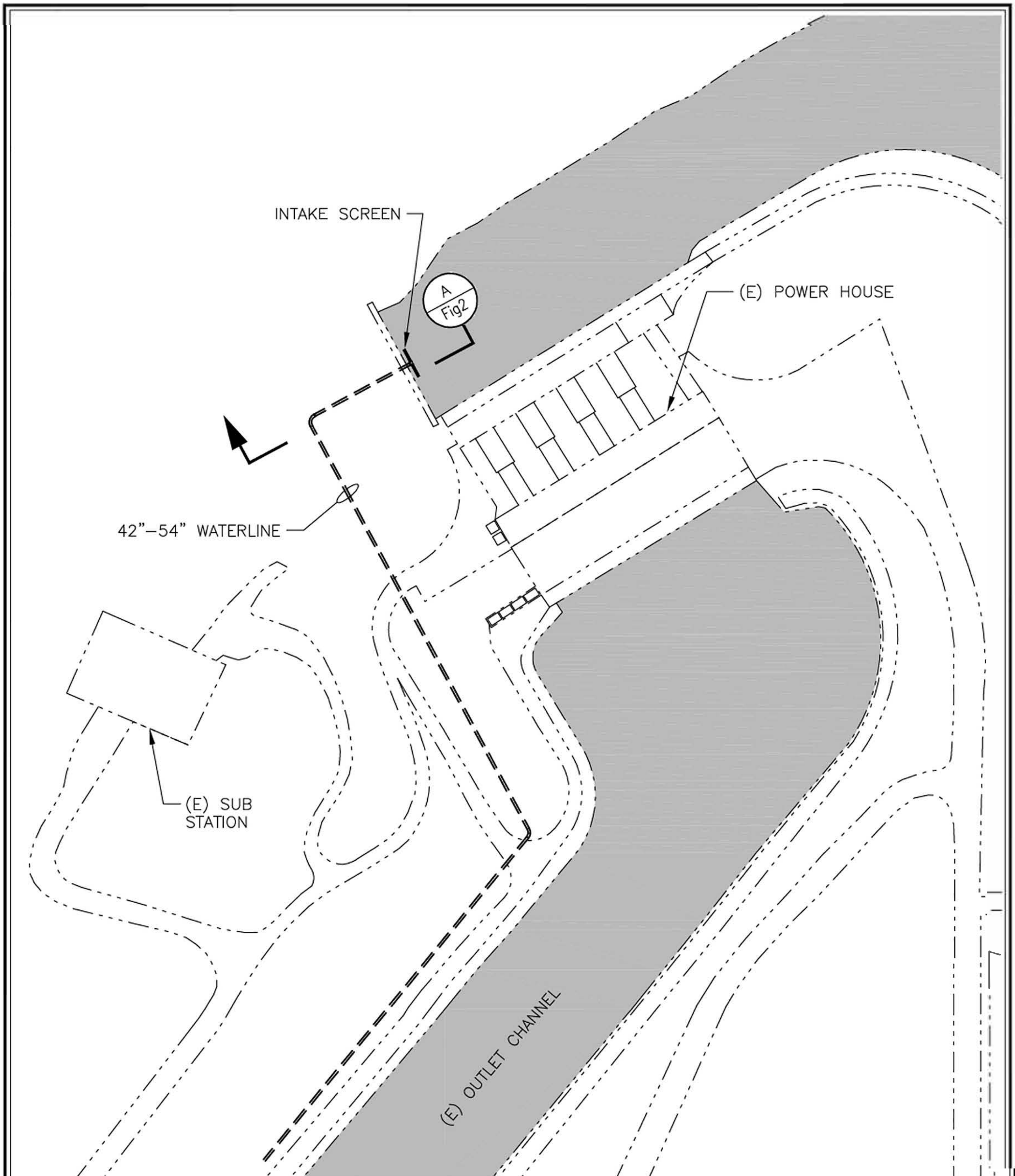
LEGEND

Highway 32 Pipeline Alignment
Overhead
Fiber Optic
Underground Telephone
Curb Gutter & Sidewalk
(E) Existing
Agg. Aggregate

Notes
1. Preliminary alignment study completed on July 12, 2012.

0 200 400
Scale in Feet

WEST YOST ASSOCIATES
Consulting Engineers



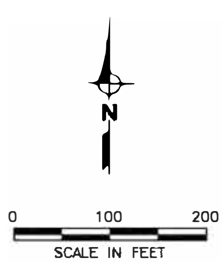


FIGURE 3

California Water Service Company
Preliminary Alignment Study

PLAN VIEW OF THE PROPOSED THERMALITO FOREBAY INTAKE CONNECTION

WEST YOST ASSOCIATES
Consulting Engineers

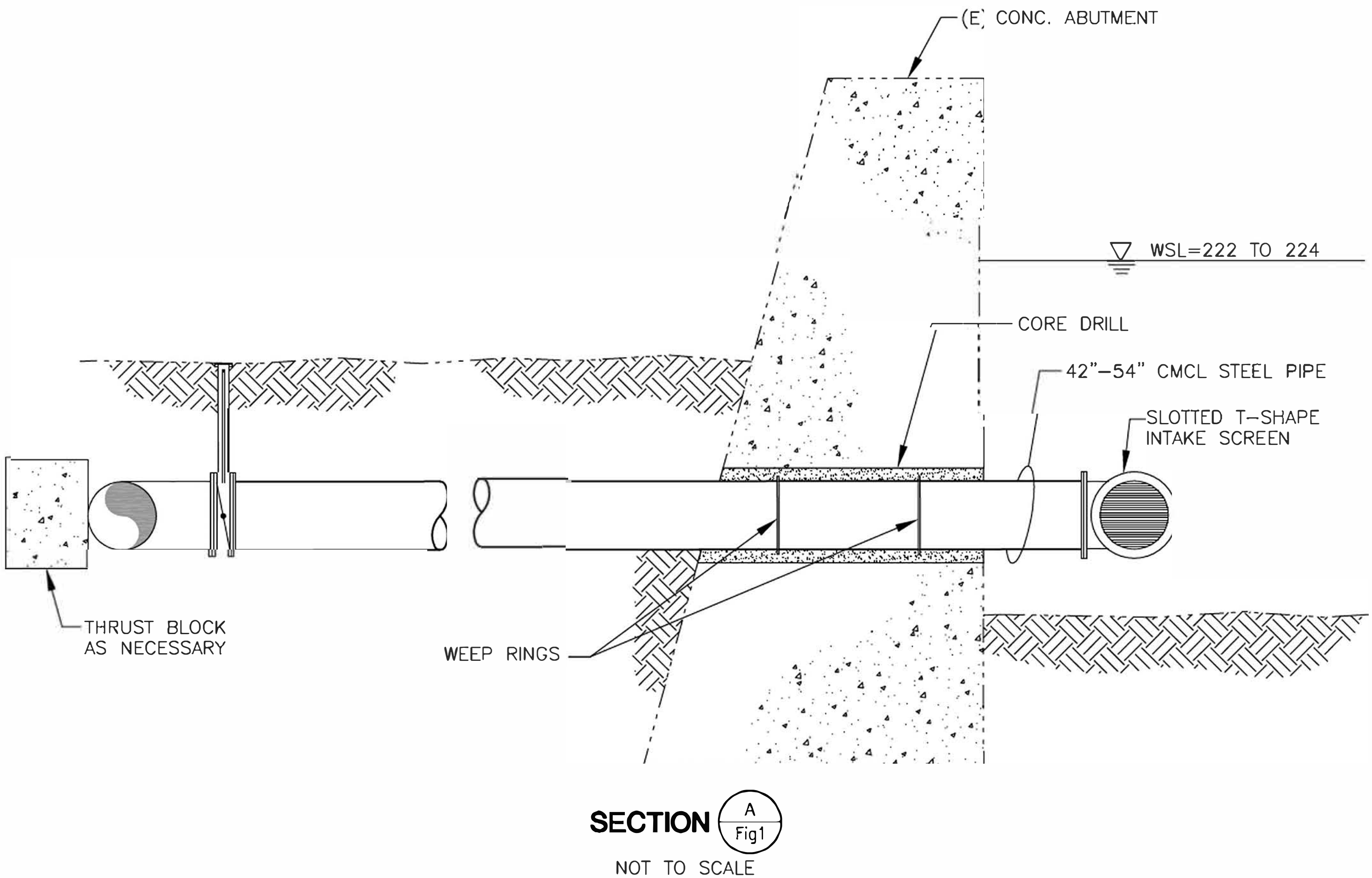
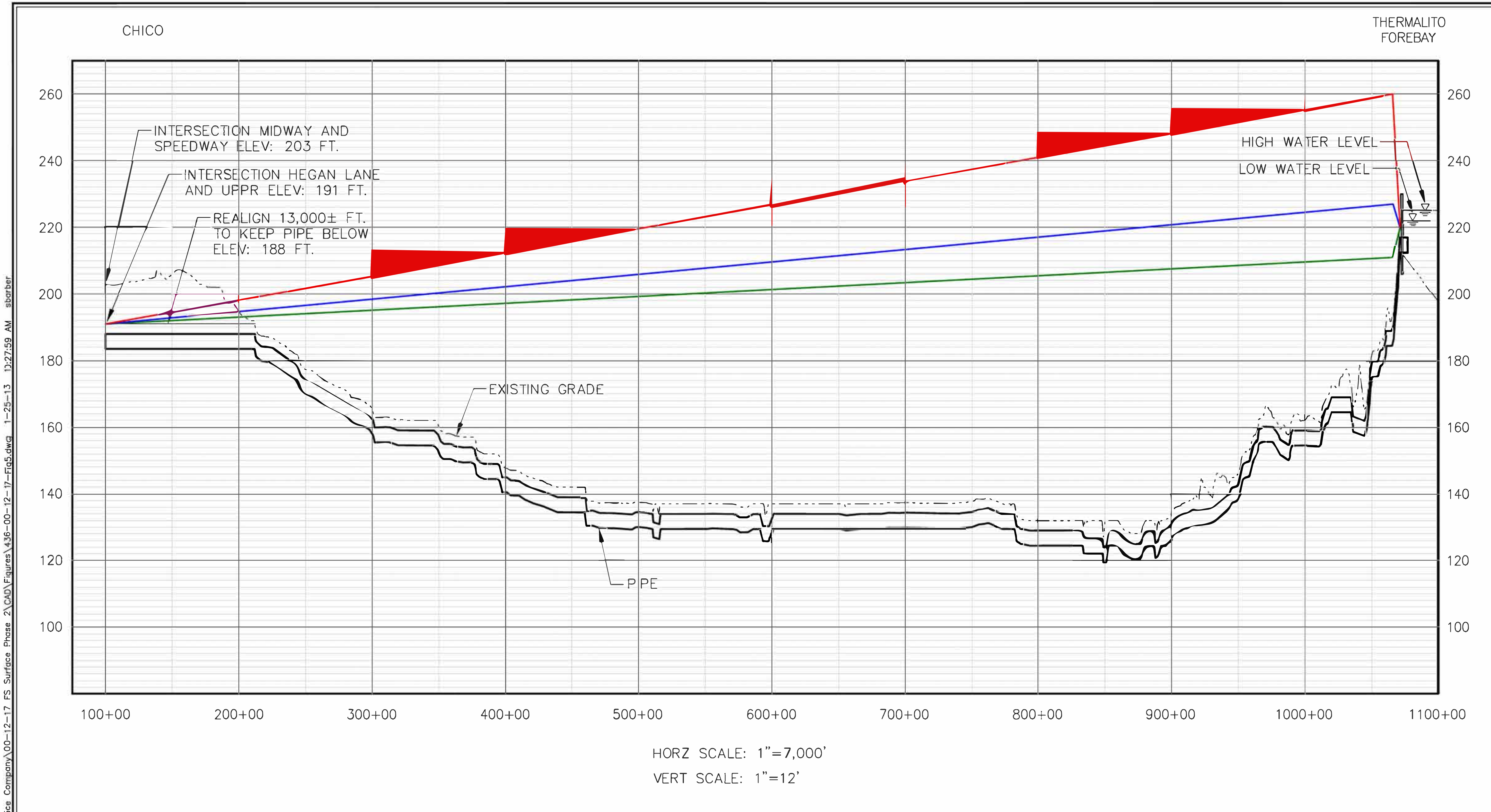


FIGURE 4

California Water Service Company
Preliminary Alignment Study

CROSS SECTION OF THE PROPOSED THERMALITO FOREBAY INTAKE CONNECTION



LEGEND

42 INCH (HP REQ. = +40 FT.)

42 INCH (HP REQ. = +7 FT.)

42 INCH (HP REQ. = −9 FT.)

FIGURE 5

California Water Service Company
Preliminary Alignment Study

HYDRAULIC GRADE LINES ALONG ALTERNATIVE 1 ROUTE

WEST YOST ASSOCIATES Consulting Engineers

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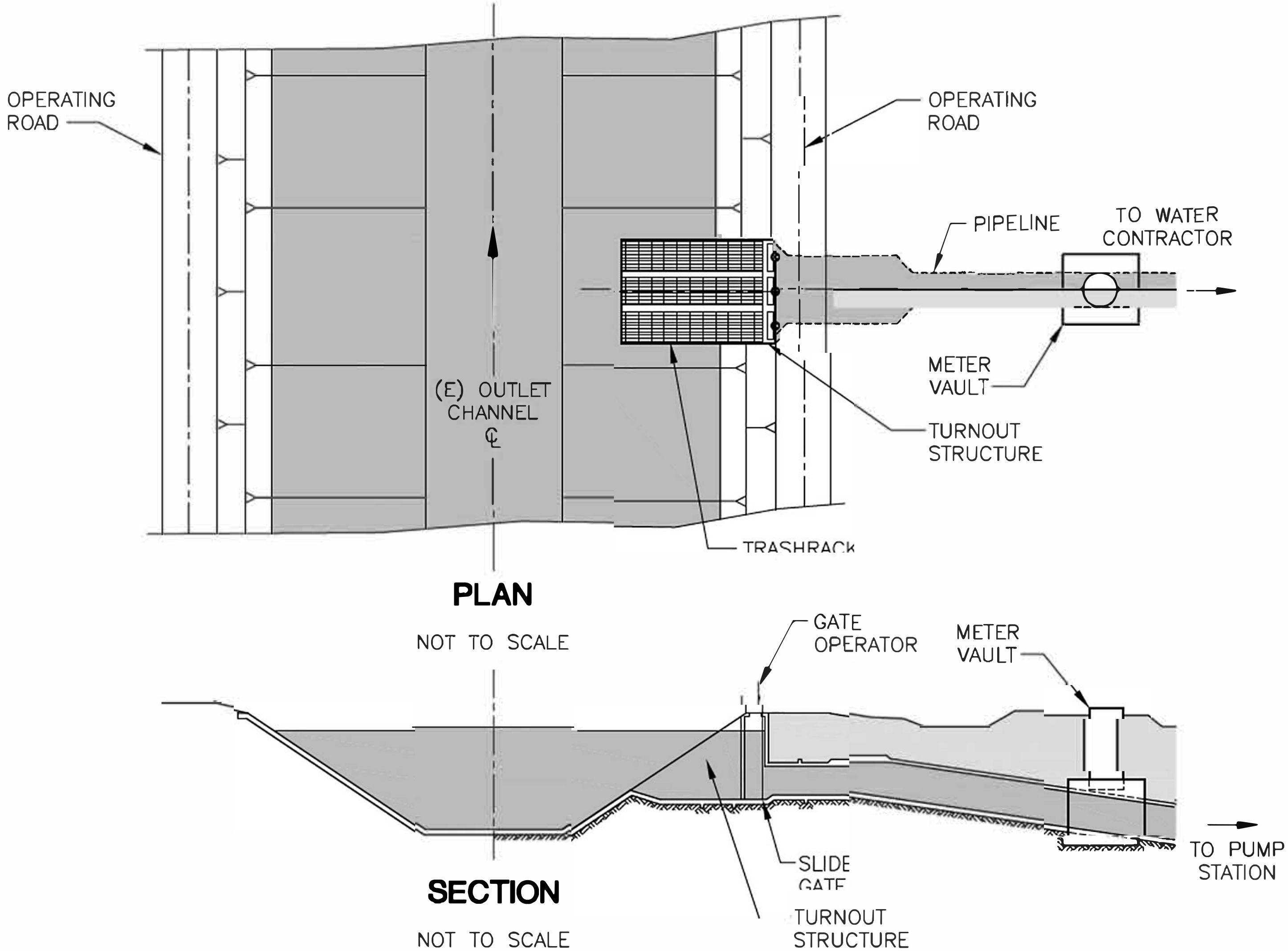

FIGURE 6

California Water Service Company
Preliminary Alignment Study

TURNOUT PLAN & PROFILE VIEW ALONG DWR CANAL

WEST YOST ASSOCIATES
Consulting Engineers

WEST YOST ASSOCIATES
Consulting Engineers

TECHNICAL MEMORANDUM

DATE:	January 21, 2014	Project No.: 436-00-13-18
TO:	Michael Pembroke, Cal Water	
CC:	Peter Bonacich, Cal Water Tom Salzano, Cal Water Michael Bolzowski, Cal Water	
FROM:	Polly Boissevain, R.C.E. #36164 Ken Loy, P.G. #7008 Amy Kwong, R.C.E. #73213	
REVIEWED BY:	Charles Duncan, R.C.E. #55498	
SUBJECT:	Surface Water Supply Feasibility Study for Cal Water's Chico District – Phase 3 – Project Justification	

OVERVIEW AND SUMMARY

This technical memorandum (TM) documents the evaluations conducted by West Yost Associates (West Yost) as part of Phase 3 of California Water Service Company's (Cal Water's) Chico District (District) Surface Water Supply Feasibility Study (Study). The purpose of the Study is to assess the feasibility of utilizing Butte County's State Water Project (SWP) long-term contract supply as a supplemental drinking water supply for Cal Water's Chico District service area in the City of Chico (City). If feasible, this proposed project could provide for the delivery of surface water supplies to the Chico District to be used conjunctively with the District's existing groundwater supply.

The proposed project would enhance the overall supply reliability and operational flexibility for the District by enabling conjunctive management of groundwater and surface water supplies. This enhancement would have two mechanisms. First, the total supply volume would be greater, increasing the likelihood that future water demands can be met, and, second, the addition of surface water supply would relieve stresses on the local groundwater supply during wetter years, allowing the aquifer to recover. This recovery would increase the amount of groundwater stored locally for use by the District in drier years. The proposed project would also provide benefits in delivered water quality by providing source capacity and operational flexibility to offset impacts to groundwater usage resulting from point sources of contamination, increasing nitrate and salt concentrations associated with agricultural land uses, and more stringent drinking water and discharge regulations.

Background

The Phase 1 evaluation was conducted in early 2012 to evaluate the reliability of Butte County's SWP supply and several potential conveyance alternatives for delivery of this surface water supply to the District (West Yost, 2012a). The Phase 1 evaluation identified the following two preferred alternatives for conveyance of surface water supplies:

- Diversion directly from the Thermalito Forebay with a transmission pipeline along the abandoned Sacramento Northern Railroad alignment to the District; and,
- Diversion from the Sacramento River using radial collector wells (requiring a surface water exchange between U.S. Bureau of Reclamation and the California Department of Water Resources (DWR)) with a transmission pipeline along Highway 32 to the District.

The Phase 1 evaluation also recommended a baseload delivery option for surface water delivery to the District as it resulted in the smallest required water treatment plant capacity. Under a baseload delivery option, a new water treatment plant with a minimum treatment capacity of 18 million gallons per day (mgd) is required.

The Phase 2 evaluation was conducted in late 2012 to further refine the two preferred conveyance alternatives (West Yost, 2012b and 2013). The Phase 2 evaluation consisted of the following tasks:

- Identifying anticipated construction, permitting and easement acquisition requirements, and estimating construction, capital and annual operating costs for the two preferred alternatives; and
- Developing a conceptual understanding of the hydrogeologic conditions in the vicinity of the proposed diversion point on the Sacramento River for the radial collector wells, and providing a preliminary hydrogeologic work plan to assess the feasibility, anticipated yield and proposed design of the radial collector wells.

Cal Water and West Yost staff met on April 24, 2013 to discuss the results of the Phase 2 evaluation. During the meeting, Cal Water staff identified several considerations that could affect the projected water demand estimates and groundwater supply availability assessment documented in the District's 2008 Water Supply and Facilities Master Plan (2008 WSFMP) (West Yost, 2008). These considerations included the following:

- The City completed its General Plan update in April 2011;
- Butte County (County) updated the Butte Basin groundwater model in Spring 2008; and
- Recent groundwater level monitoring data suggest that groundwater levels may be declining more rapidly than previously estimated.

Because of the significance of the projected water demand estimates and groundwater supply availability assessment to this Study, Cal Water staff concluded that the considerations listed above should be evaluated and relevant findings in the 2008 WSFMP updated. Evaluation of the considerations listed above would also be used to determine whether a stronger justification can be made to support the proposed surface water supply project for the District. Therefore, Cal Water requested West Yost to provide an updated evaluation of the water demand projections and groundwater level trends for the District as a part of the Phase 3 work effort.

Summary of Phase 3 Findings and Conclusions

The following list summarizes the key findings from the Phase 3 work effort.

- Water demand projections updated using the City's current 2030 General Plan land use data indicate that the District's buildout water demands are now lower than projections previously developed in the 2008 WSFMP, primarily due to changes in land use and development assumptions. Revised projections based on the current 2030 General Plan range from 33,000 acre-feet/year (af/yr) to 38,000 af/yr. These new estimates fall within the 33,000 af/yr to 41,000 af/yr estimates developed in the preliminary 2015 UWMP, but are significantly less than the 2008 WSFMP projection of 53,600 af/yr. For the purpose of this Study, 33,000 af/yr to 41,000 af/yr is considered the appropriate range for the District's buildout water demand projection.
- Although the City has grown, its capacity to accommodate new development has not increased. Therefore, the 2030 General Plan buildout timeframe is extended to 2037 based on a slower projected growth rate of 1.5 percent per year.
- Agricultural water demands account for approximately 86 percent of the total groundwater use in the County (2005-2010). This means that the impact of agricultural water demands on the groundwater basin overshadow the water demands from the District, and the sustainability of the groundwater basin is largely driven by changes in agricultural practices and hydrology, including those brought about by climate change.
- Agricultural water demands are projected to increase when climate change is considered, and the groundwater basin is projected to be further stressed due to an increase in permanent agricultural crops. Therefore, future groundwater conditions for the District are projected to deteriorate, possibly at rates higher than experienced to date.
- Groundwater level trends updated using data from both the District wells and DWR monitoring wells indicate that groundwater levels are declining at a faster rate than previously estimated, even though there has been a recent decrease in municipal groundwater production in the District. Although these trends are exacerbated by recent drought conditions, they appear to be declining over longer time periods, possibly in response to a combination of: (1) changes in the timing and amount of precipitation and runoff, and (2) changes in agricultural practices.

- Similar groundwater level declines have been observed across the region and are a measure of the reduction in groundwater storage due to groundwater withdrawals and changes in hydrology in the Sacramento River Hydrologic Region.
- The District's current and projected dependence on groundwater as its sole source of water supply does not provide long-term water supply reliability or operational flexibility when climate change is considered.
- Cal Water needs to respond to water supply vulnerabilities associated with changes in hydrology and climate that go beyond what has been experienced historically. The extremely dry conditions of 2013 and to date in 2014 may lead to a new benchmark for defining drought conditions in California, and provide additional impetus for implementing conjunctive use in the District.

Based on these findings, West Yost recommends that Cal Water continue the development of the Surface Water Supply Feasibility Study project, as it will provide the District with additional reliability and flexibility in its future water supply portfolio. The use of surface water supply conjunctively with the District's existing groundwater supply will help address projected uncertainties in future water supply availability due to reduced groundwater supply availability, resulting from deteriorating aquifer conditions, climate change and changes in agricultural practices.

The following sections of this TM provide an updated evaluation of the water demand projections and groundwater level trends in the District, and also include the findings from a brief review of the updated Butte Basin groundwater model and regional influences on the District's groundwater supply. Key findings and conclusions are then reiterated to support the recommendation to proceed with the proposed project.

UPDATED WATER DEMAND GROWTH PROJECTIONS

The City's General Plan provides direction on where and how the City will grow over time. West Yost used information in the current General Plan and also met with the City's Planning Services Department staff to discuss current assumptions for future developments in the City. West Yost developed two projections to bracket future water demand based on the current General Plan. The first uses future land use information and historical water use factors to calculate future water demand without the effects of water conservation. The second uses projected population derived from future land use information and the District's SBx7-7 2020 water conservation targets to estimate future water demand with water conservation. The following sections describe the City's current General Plan and discuss the methodologies used to update the District's water demand projections.

General Plan Update

The City's current General Plan was updated and adopted by City Council in April 2011 and reflects the preferred land use alternative selected through market analysis, land use projections, consideration of property owner requests, and consideration of a range of land use alternatives. The planning horizon for buildout in the City's General Plan is 2030.

The 2030 General Plan is intended to reflect the City's goal of sustainability and addresses development goals for the following three distinct areas of the City.

- **Areas of Stability:** Areas not anticipated to change substantially in character, land use or development intensity. These areas include most existing residential neighborhoods, environmentally sensitive lands, open spaces, and parks.
- **Areas of Potential Change:** Areas of strategic infill and redevelopment and are identified as 15 Opportunity Sites. These areas include underutilized transportation corridors, regional retail centers, areas in the City's core, and other residential, light industrial and mixed use areas that can accommodate growth.
- **New Growth Areas:** Areas to accommodate the City's future housing and job needs and are identified as five Special Planning Areas. These areas are to be developed as connected and complete neighborhoods with a mix of housing types, services, employment, and shopping opportunities, along with parks and open space.

The proposed land use diagram, as published in the 2030 General Plan, includes approximately 7,400 developable acres[1] that would accommodate a projected population of 139,700 people by 2030, which is based on a continuation of a two percent annual growth rate which has been historically observed in the City.

However, data from the 2013 Annual Progress Report for the 2030 General Plan and additional discussions with the City's Planning Services Department staff[2] project more conservative assumptions for developable land at about 3,700 acres, and a projected population of approximately 129,500 people for the District (without consideration of mixed use development and excluding Hamilton City). The primary reasons for these reductions are: (1) the exclusion of developable acreage from Resource Constraint Overlay areas, which are unlikely to develop, and (2) more conservative assumptions about development from other vacant areas by assuming that 15 percent of these lands may not develop, due to unwilling sellers, land constraints or other reasons. Resource Constraint Overlay areas include two large areas on the southeast side of the City in the Bruce Road/Skyway area and the Bruce Road/Stilson Canyon area that are primarily designated in the 2030 General Plan for low density residential development, and one large area west of the Airport that is designated for non-residential development. Figure 1 illustrates the locations of existing development and vacant parcels, including the boundaries for Resource Constraint Overlay areas, Opportunity Sites, and Special Planning Areas. As discussed above, acreages from the Resource Constraint Overlay areas were excluded as developable acreage in the City's 2013 Annual Progress Report.

The City's Planning Services Department staff also indicated that development of the Special Planning Areas is very long-term. Some of the areas, such as the North Chico Special Planning Area, west of the Airport and the Bell/Muir Special Planning Area on the west side of the City,

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[1] Source: Table LU-3 from the 2030 General Plan (5,147 acres) and includes 2,265 acres from Special Planning Areas.

[2] West Yost attended a meeting with City Planning Services Department staff on October 29, 2013.

have constraints, such as drainage issues and multiple property owners, and it is possible that some of these areas may develop in the County instead at lower densities (one-acre ranchettes). Planning staff also noted that while it is also a long-term goal of the 2030 General Plan to provide for the possibility of mixed uses, the 2030 General Plan does not require mixed use, but rather allows the possibility of mixed use development in some areas. In addition, the City's Planning staff recommended using a lower future growth projection of 1.5 percent per year rather than the two percent used in the 2030 General Plan, because while the City has grown, its capacity to accommodate new development has not increased.

Based on this information, West Yost used data from the 2013 Annual Progress Report as a reasonable long-term planning projection for the City. Use of the 2013 Annual Progress Report assumes that increases in water use from development of mixed uses would be offset by lower water use in Special Planning Areas that may not fully develop within the City, and would not likely to be served by Cal Water. With the slower projected growth rate at 1.5 percent per year, a reduced City buildout population of 124,000[3] people is projected to occur by 2037.[4] Because the District serves some unincorporated areas, the projected buildout population within the District's service area is 129,500 people (excluding Hamilton City).

Unit Water Demand Factors

Unit water demand factors for the District were updated based on the 2030 General Plan land use data and 2008 water consumption data. 2008 water consumption data were used to calculate the updated unit water demand factors because they appear to be more reflective of actual water use trends in the District before the effects of water conservation, drought and the economic downturn that have significantly reduced recent water use. Figure 2 illustrates the District's historical water production and also compares that with the projected water demand from the 2008 WSFMP. As shown, recent water production is significantly below the projected water demands developed in the 2008 WSFMP.

Table 1 summarizes the updated unit water demand factors that are recommended for use in development of the revised water demand projections. An adjustment was applied to the residential unit water demand factors to account for a net to gross area percentage of 25 percent because current parcels are assumed to be further subdivided as they become developed. The reduction in the residential unit water demand factors accounts for streets that are currently included in the vacant acreage.

[3] The 2013 Annual Progress Report projects an additional 36,300 people from the development of vacant residential land. Existing (2013) population for the City is approximately 87,700 people (*E-5 Population and Housing Estimates for Cities, Counties and the State — January 1, 2011- 2013*, California Department of Finance, May 2013).
[4] Growth in 2014 and 2015 was assumed to occur at one percent per year based on the current slow development and economic conditions.

Table 1. Recommended Unit Water Demand Factors

Revenue Class[a]	Existing Development inside the District, acres[b]	2008 Consumption, af[c]	Calculated Unit Factor, af/ac/yr	Adjusted Unit Factor, af/ac/yr[d]	Recommended Unit Factor, af/ac/yr	2008 WSFMP Unit Factor, af/ac/yr
Residential	5,094	17,359	3.4	2.6	**2.6**	3.0
Multiple Residences	1,473	3,010	2.0	1.5	**1.5**	3.1
Commercial	1,176	5,700	4.8	--	**4.8**	3.8
Industrial	509	434	0.9	--	**0.9**	2.2
Government	930	1,175	1.3	--	**1.3**	1.7

[a] Residential includes Very Low Density Residential and Single_Family land uses.
Multiple Residences includes Singlefamily_w/2nd Unit, Multi-Family_Res, and Manufactured_Home_Park land uses.
Commercial includes Retail_Trade, Services, Office, and Hotel land uses.
Industrial includes Manufacturing_Processing land use.
Government includes Public/quasi public services, Med_Services, Education_Assembly, and Common_Area land uses.

[b] Includes existing City and County parcels located within the Chico District service area.

[c] Source: *Ch_ham diff.xlsx* received on 9/25/13.

[d] Factors were adjusted to reflect a net to gross area percentage of 25 percent.

A comparison with the unit water demand factors developed in the 2008 WSFMP indicate that the Multiple Residences and Industrial factors decreased significantly, and the Commercial factor increased significantly. These differences can be mainly attributed to the changes in land use designations in the updated 2030 General Plan; acreage classified in the Multiple Residences and Industrial revenue classes increased and for Commercial decreased. In addition, the water consumption for Multiple Residences also decreased, which results in a lower unit water demand factor. Although there are significant differences when compared to the unit water demand factors developed in the 2008 WSFMP, the updated unit water demand factors are recommended for use in development of the revised water demand projections as they reflect more recent land use designation changes and water consumption in the District.

Water Demand Projections

Figure 3 illustrates the historical annual water production for the District (red line), and the projected water demand for the District based on (1) projected population estimates derived from the buildout of 2030 General Plan residential land use and the District's SBx7-7 water use targets (orange line) and (2) buildout of 2030 General Plan land use and the recommended land use based unit water demand factors (green line). This figure also compares these updated 2030 General Plan water demand projections with projected future water use from the 2008 WSFMP (blue line) and more recent Cal Water water demand projections from the preliminary 2015 UWMP (dashed black and purple lines).

As discussed above, historical trends show that water production for the District has decreased in the recent years and is significantly below the projected water demands developed in the 2008 WSFMP. The decrease in recent water production is most likely attributed to a combination of factors, including water conservation, continued implementation of the residential metering program, drought and the economic downturn.

Based on preliminary 2015 UWMP estimates prepared by Cal Water staff, projected water use for the District in 2037 is estimated to be 41,200 af/yr based on a continuation of historical use (dashed purple line), and 33,400 af/yr when factoring in future water conservation programs to comply with SBx7-7 (dashed black line).

The water demand projection using 2030 General Plan population projections is derived from existing City and District population estimates (excluding Hamilton City) and projected population increases calculated from the vacant 2030 General Plan residential land uses, using dwelling unit densities and population densities from the City's 2013 Annual Progress Report. As discussed above, a lower future growth projection of 1.5 percent per year was used to determine the buildout timeframe (*i.e.*, 2037).[5] This projection is calculated by multiplying the projected 2030 General Plan population with the District's SBx7-7 2015 and 2020 water use targets of 257 and 229 gallons per capita per day (gpcd), respectively.

[5] Growth in 2014 and 2015 was assumed to occur at one percent per year based on the current slow development and economic conditions.

The land use based water demand projection using the 2030 General Plan was developed by multiplying the amount of vacant land for each revenue class type by the recommended unit water demand factors described above. As noted previously, these unit water demand factors are based on 2008 water consumption, prior to the recent water use reductions, and do not factor in additional conservation savings to comply with SBx7-7. Therefore, the 2030 General Plan land use based water demand projection is higher than the 2030 General Plan population based water demand projection because it does not incorporate projected savings from water conservation in order to comply with SBx7-7 water use targets. However, the land use based water demand projection was reduced to account for estimated water savings from the conversion of the District's remaining residential flat rate services to metered services. The land use based water demand projection also assumes 15 percent of the Opportunity Area sites will re-develop and that Commercial development will occur in areas where mixed use is allowed. Table 2 summarizes the data used to develop the land use based water demand projection and compares this with the 2008 WSFMP water demand projection.

The updated 2030 General Plan land use based water demand projection is lower than the 2008 WSFMP projection due to a substantial reduction in developable vacant land. For example, almost 3,100 acres of vacant land designated as Non-Designated Development in the 2008 WSFMP are no longer included in the current 2030 General Plan. Also, as discussed above, the 2013 Annual Progress Report for the 2030 General Plan and discussions with the City's Planning Services Department staff project more conservative assumptions for developable land, which further reduces the water demand projection. Figures 3-5 and 3-6 from the 2008 WSFMP are included in Attachment A and can be used to compare with Figure 1 to identify the areas for Non-Designated Development and the reduction in developable vacant land, most noticeably in the Resource Constraint Overlay areas. The updated residential unit water demand factors used to develop the land use based water demand projection are also lower than the factors used previously in the 2008 WSFMP and result in a lower water demand projection.

Although the updated 2030 General Plan based water demand projections are significantly lower than the 2008 WSFMP projection, they are now much more similar to the recent water demand projections developed in Cal Water's preliminary 2015 UWMP. Both the population based water demand projections (orange and dashed black lines on Figure 3) incorporate SBx7-7 water use targets and result in essentially the same buildout water demand projection, which is equal to approximately 33,000 af/yr. The 2030 General Plan land use based water demand projection (green line on Figure 3) is slightly lower (about seven percent) than the preliminary 2015 UWMP average projection (dashed purple line on Figure 3), which is based on historical water use trends. These updated water demand projections provide bookend estimates for future water demand conditions in the District. Future water demands in the District are projected to be between 33,000 and 41,000 af/yr depending on actual water use and land development conditions. This indicates that the water demand projection developed in the 2008 WSFMP is too high based on current and projected development for the City.

Table 2. 2030 General Plan Land Use Based Water Demand Projection for New Development Areas

Revenue Class[a]	Future Development from Vacant Parcels, acres[b]	Future Development from SPAs, acres[c]	Future Development from Opportunity Sites, acres[d]	Total Future Development, acres	Recommended Unit Factor, af/ac/yr	Updated Water Demand Projection for New Development Areas, af/yr	2008 WSFMP Water Demand Projection for New Development Areas, af/yr
Residential	1,022	592	3	1,617	2.6	4,204	7,127
Multiple Residences	337	322	28	687	1.5	1,031	1,890
Commercial	411	94	110	615	4.8	2,952	2,003
Industrial	385	130	13	528	0.9	475	2,267
Government	261	24	2	287	1.3	373	693
Non-Designated[e]	-	-	-	-	--	-	10,334
Total	2,416	1,162	156	3,734	--	9,035	24,314
Savings from Metering[f]						(1,162)	(2,543)
Total with UAFW (8%)						**8,558**	**23,664**

[a] Residential includes Very Low Density Residential and Low Density Residential land uses.
Multiple Residences includes Medium Density Residential, Medium High Density Residential, and High Density Residential land uses.
Commercial includes Commerical Services, Neighborhood Commerical, Regional Commerical, Commercial Mixed Use, Office Mixed Use, Residential Mixed Use, and Special Mixed Use land uses. Water demand projection assumes that increases in water use from development of mixed uses would be offset by lower water use in Special Planning Areas that may not fully develop within the City.
Industrial includes Manufacturing & Warehousing and Indsutrial/Office Mixed Use land uses.
Government includes Public Facilities and Services land use.

[b] Includes (1) existing City parcels that are not currently served by the District, but will require water service in the future, (2) vacant parcels located inside the City's planned Sphere of Influence, and (3) vacant County parcels located outside City limits, but within the District service area. Does not include parcels inside the Resource Constraint Overlay. Total vacant parcel area reduced by 15 percent to account for properties that may not develop due to various constraints.

[c] Acreages reduced by 15 percent to account for properties that may not develop due to various constraints.

[d] Assumes that 15 percent of the area within the identified Opportunity Sites will be redeveloped with intensified land uses.

[e] Assigned to known future development without defined land uses.

[f] Water savings from metering equal to 0.23 af/service/yr (2008 WSFMP).
2012: 5,053 flat rate services remaining for conversion.
2008 WSFMP: Estimated conversion of 11,182 flat rate services.

RECENT GROUNDWATER LEVEL TRENDS

Groundwater wells in the District currently pump groundwater from the Vina and West Butte sub-basins. Cal Water is currently operating a total of 62 active groundwater wells (41 wells in the Vina sub-basin and 21 wells in the West Butte sub-basin).[6]

Historical groundwater level trends fluctuate depending on annual hydrologic conditions. These natural fluctuations do not necessarily indicate the presence of overdraft conditions; instead, the long-term trend over many years is more indicative of whether overdraft conditions exist or not. In addition, the geology and historical management practices also vary from basin to basin; consequently, the magnitude of groundwater level decline that would be indicative of overdraft conditions varies by basin. For planning purposes in the 2008 WSFMP, a sustained, long-term rate of groundwater level decline greater than 0.75 feet per year (ft/year) was used to indicate the potential presence of overdraft conditions in the groundwater basin.

The 2008 WSFMP groundwater level trends evaluation projected a near-term stability in groundwater levels. To provide an update to this evaluation, more recent groundwater level data was provided by Cal Water staff or obtained from DWR for each of the wells used in the 2008 WSFMP evaluation. The following sections first provide a brief summary of the results from the 2008 WSFMP groundwater level trends evaluation and then present additional findings and conclusions from the evaluation of more recent groundwater level trends.

Summary of Groundwater Level Trends Evaluation from the 2008 WSFMP

Findings from the 2008 WSFMP indicate that groundwater levels within the sub-basins used by Cal Water to supply the District appear to be stable or showing very minor groundwater level declines in isolated wells. Only two active groundwater wells (Stations 5 and 34) had groundwater level declines greater than 0.75 ft/year, and these wells appear to have isolated, localized issues that need to be further investigated. Additionally, long-term groundwater level trends in the DWR wells reviewed in the Chico area appear consistent with the stable groundwater levels observed in the Cal Water wells. The 2008 WSFMP concluded that overdraft conditions were not likely present in the Vina and West Butte sub-basins based on the data reviewed.

Figures 4-3 and 4-11 from the 2008 WSFMP (Attachment B) provide a summary of the historical average spring groundwater levels in the District's groundwater wells in the Vina and West Butte sub-basins, respectively. As shown on these figures, the historical average groundwater level decline for the District's wells in the Vina and West Butte sub-basins are approximately 0.09 ft/year and 0.10 ft/year, respectively. These historical groundwater level trends do not indicate overdraft conditions in the groundwater aquifer.

Figure 4-5 from the 2008 WSFMP (Attachment B) presents the locations of the District groundwater wells and highlights wells with a rate of groundwater level decline greater than 0.75

[6] Includes four State wells (CH-S-1, CH-S-2, CH-S-3, and CH-S-4) located inside the District service area. These wells were developed as part of a lawsuit settlement with California Department of Toxic Substances Control.

ft/year in red. These three wells were further evaluated to determine potential reasons for the higher rate of groundwater level decline. Station 33 had two data outliers; removing these outliers results in an historical average groundwater level decline less than 0.75 ft/year. Stations 5 and 34 appear to have isolated, localized issues that need to be further investigated.

Although the historical groundwater levels did not indicate the presence of overdraft conditions based on the criterion used at that time, the 2008 WSFMP recommended close monitoring of groundwater levels due to the significant projected increase in water demands within the District.

Evaluation of Recent Groundwater Level Trends

To provide an update to the 2008 WSFMP evaluation, more recent groundwater level data were provided by Cal Water staff and obtained from DWR for each of the wells used in the 2008 WSFMP evaluation. Figures 4 and 5 provide an updated summary of the historical average spring groundwater levels in the District's groundwater wells in the Vina and West Butte sub-basins, respectively. As shown on these figures, the historical average groundwater level rates of decline for the District's wells in the Vina and West Butte sub-basins have increased slightly and are now approximately 0.44 ft/year and 0.43 ft/year, respectively. Although these updated historical groundwater level trends do not indicate overdraft conditions in the groundwater aquifer, they do indicate that the groundwater levels in the District are declining at a faster rate than previously estimated.

Table 3 summarizes the difference in the historical average spring groundwater level trends between the 2008 WSFMP and the more recent data for the District's wells, and also highlights wells with a current rate of groundwater level decline greater than 0.75 ft/year in red. Four additional active groundwater wells are showing groundwater level declines greater than 0.75 ft/year. Table 3 also indicates that there are five wells that have a current rate of groundwater level decline closely approaching 0.75 ft/year (within ten percent). These five wells are highlighted in yellow in Table 3.

In addition to showing that the rates of decline are greater than previously estimated, Table 3 also indicates that the current (2013) groundwater elevations in most of the District's wells are lower than previously presented in the 2008 WSFMP. It should be noted that Table 3 may overstate the differences between historical and current (2013) groundwater elevations because 2006 was a wet year and recent years have been dry with 2013 being the driest year on record.

Updated data from DWR wells located in the Vina and West Butte sub-basins were also evaluated and appear generally consistent with the slight increase in the rate of groundwater level decline observed in the Cal Water wells. Attachment C provides a map and the updated individual spring groundwater level hydrographs for the eight DWR wells evaluated in the Vina and West Butte sub-basins.

Table 3. Summary of Spring Groundwater Level Conditions in the Chico District Wells[(a,b)]

Well ID	Current Status[(c)]	Sub-basin	2008 WSFMP Groundwater Level Trend, ft/year[(d)]	Updated Groundwater Level Trend, ft/year[(d)]	Change in Groundwater Level Trend, ft/year[(e)]	2006 Groundwater Level Elevation, ft msl[(f)]	2013 Groundwater Level Elevation, ft msl[(f)]	Change in Groundwater Level Elevation, ft msl[(g)]
W-001-04	Standby	West Butte	-0.13	-0.33	**-0.20**	133	125	**-8**
W-003-03	Standby	West Butte	Insufficient Data for Comparison			Data Not Available		
W-005-02	Active	West Butte	-0.91	-0.70	**0.21**	114	123	**9**
W-007-04	Active	West Butte	0.73	-0.01	**-0.74**	133	137	**4**
W-008-01	Active	Vina	-0.04	-0.28	**-0.24**	136	128	**-8**
W-011-01	Active	West Butte	-0.22	-0.49	**-0.27**	136	129	**-7**
W-012-01[(h)]	Active	Vina	0.06	-0.29	**-0.35**	137	125	**-12**
W-014-01	Active	Vina	1.24	-0.14	**-1.38**	146	124	**-22**
W-016-01	Active	Vina	-0.63	-1.07	**-0.44**	138	122	**-16**
W-017-01	Active	Vina	0.28	-0.24	**-0.52**	143	132	**-11**
W-018-01	Active	West Butte	0.05	-0.35	**-0.40**	133	125	**-8**
W-019-01	Active	Vina	-0.03	-0.78	**-0.75**	137	113	**-24**
W-020-01	Active	Vina	0.61	-0.08	**-0.69**	137	125	**-12**
W-021-01	Active	Vina	0.24	-0.61	**-0.85**	145	124	**-21**
W-022-01	Active	Vina	0.08	-0.62	**-0.70**	139	121	**-18**
W-023-01	Active	West Butte	-0.44	-0.56	**-0.12**	130	125	**-5**
W-024-01	Active	Vina	-0.25	-0.68	**-0.43**	129	123	**-6**
W-025-01	Active	Vina	-0.02	-0.29	**-0.27**	141	133	**-8**
W-026-01	Active	Vina	-0.67	-0.61	**0.06**	126	125	**-1**
W-027-01	Active	Vina	-0.11	-0.30	**-0.19**	144	129	**-15**
W-028-01	Active	Vina	-0.01	-0.67	**-0.66**	140	127	**-13**
W-029-01	Active	Vina	-0.05	-0.05	**0.00**	127	131	**4**
W-030-01	Active	Vina	-0.27	-0.38	**-0.11**	145	135	**-10**
W-031-01	Active	Vina	-0.11	-0.41	**-0.30**	135	127	**-8**
W-032-01	Active	Vina	1.17	-0.23	**-1.40**	147	120	**-27**
W-033-01	Active	Vina	-0.34	-0.44	**-0.10**	129	125	**-4**
W-034-01	Active	Vina	-0.90	-1.26	**-0.36**	131	126	**-5**
W-035-01[(h)]	Active	West Butte	-0.09	-0.49	**-0.40**	129	115	**-14**
W-037-01	Active	Vina	-0.13	-0.16	**-0.03**	138	140	**2**
W-038-01	Active	Vina	0.11	-0.73	**-0.84**	139	125	**-14**
W-039-01	Active	West Butte	-0.43	-0.69	**-0.26**	128	122	**-6**
W-041-01	Active	West Butte	0.12	-0.34	**-0.46**	127	122	**-5**
W-042-01	Active	West Butte	-0.25	-0.37	**-0.12**	133	127	**-6**
W-044-01	Active	Vina	-0.27	-0.27	**0.00**	115	116	**1**
W-046-01	Active	West Butte	-0.02	-0.52	**-0.50**	134	117	**-17**
W-047-01	Active	Vina	0.17	-0.18	**-0.35**	142	132	**-10**
W-048-01	Active	Vina	-0.39	-0.61	**-0.22**	145	135	**-10**
W-049-01	Active	Vina	-0.10	-0.54	**-0.44**	125	120	**-5**
W-050-01	Active	West Butte	-0.12	-0.49	**-0.37**	137	127	**-10**
W-051-01	Active	West Butte	0.29	-0.22	**-0.51**	123	116	**-7**
W-052-01	Inactive	Vina	0.13	-0.04	**-0.17**	164	156	**-8**
W-053-01	Active	West Butte	-0.10	-0.43	**-0.33**	120	115	**-5**
W-054-01	Active	West Butte	-0.55	-0.69	**-0.14**	130	126	**-4**
W-056-01	Active	Vina	-0.01	-0.15	**-0.14**	135	135	**0**
W-057-01	Active	West Butte	-0.34	-0.86	**-0.52**	130	116	**-14**
W-059-01	Active	Vina	-0.13	-0.15	**-0.02**	116	128	**12**
W-061-01	Active	West Butte	0.95	-0.03	**-0.98**	143	123	**-20**
W-062-01	Active	Vina	-0.11	-0.30	**-0.19**	135	129	**-6**
W-063-01	Active	Vina	0.23	-0.11	**-0.34**	140	130	**-10**
W-064-01	Active	Vina	-0.35	-0.43	**-0.08**	145	153	**8**
W-065-01	Active	West Butte	-0.37	-0.65	**-0.28**	120	117	**-3**
W-067-01	Active	West Butte	-0.68	-0.89	**-0.21**	131	123	**-8**
W-068-01	Inactive	Vina	Insufficient Data for Comparison			108	127	**19**
W-069-01	Active	Vina				136	127	**-9**
W-070-01	Active	Vina				127	126	**-1**
W-071-01	Active	West Butte				123	120	**-3**
W-072-01	Active	Vina				133	128	**-5**

(a) For consistency in comparison, only wells evaluated in the 2008 WSFMP are included in this table.

(b) Wells with a current (2013) declining groundwater level trend greater that 0.75 ft/year are highlighted in red.

(c) Based on status provided in *CH Data Package.xlsx* file.

(d) Linear trend based on available historical annual spring groundwater level data (i.e., highest groundwater level recorded in either February, March or April).

(e) 2006 trend subtracted from 2013 trend.

(f) Based on highest groundwater level recorded in either February, March or April.

(g) 2006 elevation subtracted from 2013 elevation.

(h) 2006 elevation data not available, 2005 data was used instead.

Regional Groundwater Elevation and Groundwater Pumping Trends

The declining groundwater level trends identified in the localized Chico area are consistent with recent historical trends in groundwater levels in the greater Northern Sacramento Valley Groundwater Basin, including the parts of the groundwater basin beneath Butte County. DWR Northern Region Office maintains a website[7], which documents changes in groundwater levels in numerous groundwater wells across the region for the time period from spring 2004 through spring 2013. The wells monitored are categorized as shallow (less than 200 feet), intermediate (200 - 599 feet), and deep (600 feet and greater). The District's wells are in the intermediate depth range. Attachment D provides the DWR Northern Region Office maps showing the differences in groundwater levels between spring 2004 and spring 2013 for shallow, intermediate, and deep wells. These maps demonstrate that groundwater levels have declined in all three depth zones over the last decade. The intermediate depth zone experienced the greatest decline in groundwater levels, which approached 30 feet in some areas of the groundwater basin, and more than 20 feet of decline was mapped to the southeast of the City (see Plate 1I-B in Attachment D).

Groundwater pumping is a major driver for the declining groundwater trends in Butte County, but the available information needed to quantify the pumping is very limited. Butte County prepares Water Inventory and Assessment (WIA) reports on an occasional basis, but the most recent of these reports was prepared in 2001. Butte County is currently working on an update, which will be used as part of the planned update to the Butte Basin groundwater model, but the updated WIA report is not scheduled to be released until the end of 2014.

The best, most current, available information on historical groundwater pumping in Butte County is probably the Draft California Water Plan Update 2013.[8] Table 4 summarizes the estimated changes in groundwater supply in the Sacramento River Hydrologic Region for the period from 2001 through 2010 (DWR, 2013). Precipitation as a percentage of normal precipitation is listed for each year.

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[7]http://www.water.ca.gov/groundwater/data_and_monitoring/northern_region/GroundwaterLevel/gw_level_monitoring.cfm
[8]http://www.waterplan.water.ca.gov/cwpu2013/prd/index.cfm

Table 4. Estimated Changes in Groundwater Supply in the Sacramento River Hydrologic Region (2001-2010)[a]

Water Year (Percent of Normal Precipitation)	Change in Groundwater Supply[b], TAF
2001 (67%)	-1,148
2002 (91%)	-1,418
2003 (99%)	-1,470
2004 (90%)	-1,639
2005 (127%)	-1,211
2006 (139%)	-1,576
2007 (65%)	-1,939
2008 (68%)	-2,049
2009 (80%)	-1,968
2010 (96%)	-1,745

[a] Source: Public Review Draft California Water Plan Update 2013.
[b] Change in groundwater supply = intentional recharge + deep percolation of applied water + conveyance deep percolation and seepage – withdrawals. Does not include unknown factors such as natural recharge/discharge and subsurface inflows and outflows.
TAF = thousand acre-feet

The estimated changes in groundwater supply are calculated using the following equation:

$$\Delta GW = R_i + DP_{aw} + DP_c - W, where$$

$$\Delta GW = Change\ in\ groundwater\ supply$$

$$R_i = Intentional\ recharge$$

$$DP_{aw} = Deep\ percolation\ of\ applied\ water$$

$$DP_c = Conveyance\ deep\ percolation\ and\ seepage$$

$$W = Groundwater\ Withdrawals$$

Although the equation does not account for natural recharge and discharge, and subsurface inflows and outflows, it does provide evidence that, in recent years, groundwater pumping has exceeded the sources of artificial recharge specified in the water balance equation listed above by more than a million acre-feet per year, irrespective of the percentage of normal precipitation in each given year. By conservation of mass, any such deficits will result in some combination of a reduction in groundwater storage and a reduction in subsurface outflows and stream flow. The observed declines in groundwater levels regionally and near the City are a measure of the reduction in groundwater storage.

The historical pumping in the District's wells makes up a small fraction of the groundwater pumping in the basin, and this is projected to be the case in the future as agricultural pumping dominates the region's groundwater withdrawals. Table 5 summarizes the average groundwater usage for the period from 2005 through 2010 for agricultural, urban and managed wetland uses in Butte County. Agricultural use accounted for approximately 86 percent and urban use accounted for approximately 12 percent of the total groundwater use for the period, with the remaining two

percent used in managed wetlands. This indicates that even small percentage increases in agricultural water demand will overshadow the reduced level of buildout water demands projected for the District in this Study. Future trends in the regional agricultural land and water use are discussed in the next section.

Table 5. Butte County Average Annual Groundwater Supply by Type of Use (2005-2010)

Agriculture Use Met by Groundwater		Urban Use Met by Groundwater		Managed Wetlands Use Met by Groundwater		Total Water Use Met by Groundwater	
TAF	Percent	TAF	Percent	TAF	Percent	TAF	Percent
367.7	32%	51.0	73%	9.1	9%	427.8	32%

Source: Public Review Draft California Water Plan Update 2013

Notes:

1) TAF = thousand acre-feet
2) Percent use is the percent of the total water supply that is met by groundwater.
3) 2005-2010 precipitation equals 96 percent of the 30 year average for the Sacramento River Hydrologic Region.
4) Total Water Supply = Groundwater + Surface Water + Reuse

Future Trends in Agricultural Land and Water Use

Butte County's most recent estimate of agricultural water demand was made in 2003 and predicted a 10 percent decrease in agricultural land use by 2030 (CDM, 2003a). Similarly, the Draft California Water Plan Update 2013 forecasts a reduction in agricultural water demand for all urban growth scenarios, when climate change is not considered. This reduction in agricultural water demand is projected mostly based on the reduction in agricultural land area resulting from urban growth and savings from water conservation. More significantly for this Study, agricultural demands are forecasted to increase under most urban growth scenarios when climate change is considered (DWR, 2013). According to the Draft California Water Plan Update 2013 regarding the Sacramento River Hydrologic Region,

> "…when considering the potential effects of future climate change many scenarios show an increase in agricultural water demand even when there is a reduction in irrigated crop area as shown in Table SR-25. Under high population scenarios the decrease was about 50 thousand acre-feet, but under the three low and current trend population scenarios, the average increase in water demand was about 110 thousand acre-feet and 200 thousand acre-feet, respectively, when compared with historical average of 7,490 thousand acre-feet."

Other factors, not yet reflected in published agricultural water demand estimates, may also cause agricultural water use to increase in the future. It is commonly known that the Sacramento Valley has experienced a significant expansion in land area planted with permanent crops, such as tree crops and vineyards, in recent years, and this trend is expected to continue. Expansion of permanent crops places additional pressure on the groundwater supply for several reasons. First, by definition, these crops cannot be fallowed during drought conditions when surface water supplies are curtailed or not available; they must be supplied by groundwater pumping. Second, in

many cases, permanent crops are being developed on previously dry lands not served by irrigation districts with surface water supplies, thus creating new demand for groundwater. Third, permanent crops are often irrigated with drip irrigation systems that require water with low turbidity. Therefore, groundwater is used in these systems because of the high cost of removing turbidity from surface water supplies. Fourth, for some crops, such as almonds, relatively high water consumption is economically justified by higher crop yield and farm revenue. In recent years, consumptive water use by almond trees in the Central Valley has been found to be similar to alfalfa, which is a water-intensive crop.

Findings and Conclusions from Recent Groundwater Level Trends

Findings from the updated groundwater level trend evaluation are summarized below:

- Rates of groundwater level decline increased in both the Vina and West Butte sub-basins;
- The current groundwater level is the lowest it has been in 25 years;
- Since 1998, the groundwater levels in the Vina and West Butte sub-basins have decline by 20 and 19 feet respectively;
- The lowest historical average spring groundwater level occurred in 2013 for most wells;

  Groundwater levels in the District's wells have decreased by approximately ten feet during the past ten years;
- Although municipal groundwater production has decreased in the District for the recent years, groundwater levels are still declining; and
- Regionally, groundwater levels have also declined, and this trend is expected to continue in response to increasing agricultural demands for groundwater.

Taken together, the recent declines in groundwater levels in the District's service area, including the similar declines observed across the region, and projected trends in agricultural land and water use indicate that groundwater levels in the District will continue to decline in the future, possibly at rates higher than experienced to date, especially if water demands from the surrounding groundwater aquifer are increased or recharge rates decrease due to changes in precipitation or land use.

GROUNDWATER MODELING

The Butte County Department of Water and Resource Conservation's Butte Basin Integrated Water Flow Model (BCIWFM) potentially provides a tool for simulating future groundwater conditions for the two preferred conveyance alternatives. For this Study, the BCIWFM files and documentation for the Calibration and 2030 Base Case versions of the model were obtained from Butte County and reviewed. The primary focus of the review was to assess the levels of demand incorporated in the model for the purpose of determining whether, and to what extent, the 2030 water demands would need to be updated to be consistent with the updated water demand projection estimated for the District as part of this Study. Secondarily, the assumptions for the agricultural water demands simulated in the 2030 Base Case model were also evaluated to assess

their reasonableness. Lastly, the review also assessed if the BCIWFM would be the appropriate tool for use in evaluating the two preferred conveyance alternatives.

The Calibration version of the BCIWFM simulates historical conditions, including hydrology, land use and water use, for water years 1971 through 1999 (CDM, 2008a). These historical inputs were used in the Calibration model to iteratively adjust the aquifer and other hydraulic parameters (*e.g.*, hydraulic conductivity and storage coefficient) until an acceptable water budget and match between simulated and observed groundwater levels were achieved. The Calibration version represents historical urban demands, which are met by groundwater, as defined model input specified as groundwater pumping at specific well locations. The model input specifies 62 wells in the District's service area. Figure 6 shows the historical annual groundwater pumping simulated in the Calibration version of the model in the District's service area. Simulated pumping, or equivalently, demand, increased from approximately 15,000 acre-feet to 27,000 acre-feet over the simulated 29-year period from water year 1971 to 1999.

The calibrated parameters from the Calibration version of the model were subsequently used to the develop the 2030 Base Case version of the model, which incorporated updated land use, urban pumping, and surface water diversions projected to the year 2030 (CDM, 2008b). The purpose of the 2030 Base Case version of the model was to simulate 2030 baseline groundwater conditions to which a specific water management scenario developed by the Butte County could be compared.

The 2030 Base Case version simulation used the historical time series data from the Calibration version of the model with some modification, resulting in a 29-year simulation. Precipitation data from water years 1971 through 1999 were used. Surface water diversions were approximated based on the last five years of historical diversions used in the Calibration version (water years 1995-1999). The diversions were adjusted based on the hydrologic conditions for each year of the simulation using the water year index. Agricultural land use was adjusted to forecasted 2030 conditions, which entailed an approximate 10 percent decrease in the area of irrigated agriculture between 1998/1999 and 2030 (CDM, 2003a). Irrigation efficiencies were also adjusted based on agricultural forecasts (CDM, 2003a).

Urban groundwater pumping in Chico was assumed to increase by 96 percent under a 2030 level of water demand (CDM, 2008b).[9] Comparison of the Calibration and 2030 Base Case version input files reveals an apparent deviation from the 96 percent increase in demand cited. Table 6 summarizes the demands from the BCIWFM input files. Based on these totals, the 1999 to 2030 increase in simulated urban water demand is 65 percent and is much lower than the 96 percent increase cited by CDM. However, the 44,749 af/yr of groundwater pumping simulated for the City in the 2030 Base Case version of the model is more similar to the upper limit of the range for water demands estimated in the preliminary 2015 UWMP.

[9] Water demand projected to increase from 28,069 acre-feet in 2000 to 55,037 acre-feet in 2030 (CDM, 2003b).

Table 6. City of Chico Groundwater Pumping Simulated in the BCIWFM		
Water Year	Water Demand, acre-feet	BCIWFM Version
1999	27,158	Calibration
2030	44,749	2030 Base Case

Figure 7 is a simulated hydrograph of groundwater levels in the western part of the City generated using the 2030 Base Case version of the BCIWFM. Simulated groundwater levels are shown for model layers 5 and 6, which encompass the depth intervals of the District's wells. The groundwater levels are very similar in both layers and exhibit a declining trend over much of the 29-year simulation.

The current version of the 2030 Base Case version of the BCIWFM could be used with updated buildout water demands for the District to simulate the differences in groundwater levels with and without each of the two preferred conveyance alternatives. Used in this way, Cal Water could apply the model to assess how changes in the availability of the surface water will affect groundwater levels in the District's wells for each of the alternatives. The need for such an effort will depend on Cal Water's decision on whether or not to pursue the proposed project.

CLIMATE CHANGE AND WATER SUPPLY PLANNING

Climate change causes alterations in temperature and precipitation patterns, which impact water resources. Mean temperatures are expected to rise in many parts of North America as a result of climate change. Higher average temperatures will not only increase water evaporation rates, but will also change the quantity, intensity and timing of precipitation. Increases in mean temperatures can also affect the amount and duration of snow cover. All of these factors that could arise from climate change have important implications on water supply availability.

Most climate models predict that climate change will decrease the ability of the Sierra snowpack to serve as California's natural water storage system, and some projections forecast that the Sierra snowpack could decline between 70 and 90 percent[10]. Changes in the Sierra snowpack will depend in part on future precipitation patterns. Updated precipitation data for the Chico area indicate that the average precipitation has decreased by approximately one-inch since the completion of the 2008 WSFMP report. Further decreases in precipitation could worsen the region's water supply availability.

In the future, Cal Water will need to respond to water supply vulnerabilities associated with changes in hydrology and climate that go beyond what has been experienced historically. Consequently, understanding and planning for potential impacts from climate change are critical to ensure that the District's water supply portfolio can be resilient to future conditions. It should be noted that climate change is receiving increasing attention in planning documents. For example, the City's 2030 General Plan has a specific "Sustainability Element" that emphasizes

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[10] *Our Changing Climate: Assessing the Risks to California*, California Climate Change Center, July 2006.

reducing contributions to climate change. The Draft California Water Plan Update 2013 also provides an evaluation of climate change and concludes that agricultural demands will increase in the Sacramento River Hydrologic Region for all climate change scenarios, except for those assuming high urban growth.

Although there are many uncertainties regarding how climate change will impact the State's water resources, there is potential for climate change to decrease the existing and projected groundwater supply availability for the District. The District's current and projected dependence on groundwater as its sole source of water supply does not provide long-term water supply reliability or operational flexibility when climate change is considered. Therefore, it is recommended that the District plan and develop alternative water supply strategies to cope with the potential water supply impacts resulting from climate change.

PROJECT JUSTIFICATION

Table 7 summarizes the key findings and conclusions from the Phase 3 work effort. Based on these findings and conclusions from the Phase 3 work effort, West Yost recommends that Cal Water continue the development of the Surface Water Supply Feasibility Study project. The extremely dry conditions of 2013 and to date in 2014 may lead to a new benchmark for defining drought conditions in California and provide additional impetus for implementing conjunctive use in the District. Fulfilling the goal of utilizing surface water as a supplemental drinking water supply in the District will provide the following benefits:

- Reduce dependence on the groundwater supply and provide additional reliability and flexibility in the District's future water supply portfolio;
- Address projected uncertainties in future water supply availability due to reduced groundwater supply (from increased water use from other users and/or deteriorating aquifer conditions), climate change (extended drought conditions), and other factors;
- Improve groundwater levels for District wells through in-lieu banking of local groundwater; and
- Improve environmental, operational and water quality conditions for multiple parties, including slowing the movement of contaminate plumes within the District service area by decreasing the pumping at well nearby.

The following tasks are recommended to continue the development of the project and can be completed as additional phases to the Surface Water Supply Feasibility Study.

- Re-evaluate options to deliver surface water via Butte Creek[11]
- Groundwater modeling to assess how groundwater levels respond to surface water use under the preferred alternatives

[11] This task was requested by Cal Water staff during a meeting held with West Yost on April 24, 2013.

- Perform site-specific studies at the proposed point of diversion for the radial collector wells
- Layout conceptual transmission facilities for both preferred conveyance alternatives
- Groundwater recharge basin evaluation
- Water treatment plant evaluation
- Analysis/Selection of Preferred Alternative

Table 7. Summary of Key Findings and Conclusions from the Phase 3 Work Effort

Issue	Findings	Conclusions
Water Demand Projection	• Current development conditions in the City project more conservative assumptions for developable land • Updated water demand projections indicate that the District's buildout water demands are now significantly lower than the 2008 WSFMP projection • The 2030 General Plan buildout timeframe is extended to 2037 based on a slower projected growth rate of 1.5 percent per year • Agricultural water demands account for a majority of the groundwater use in the County • Agricultural water demands are projected to increase when climate change is considered • The Sacramento Valley has experienced an expansion in land area planted with permanent crops and this trend is expected to continue	• Impact of agricultural water demands on the groundwater basin overshadow the lower buildout water demand projection for the District • Agricultural water demand is projected to increase due to climate change and rise in permanent crops • Permanent crops will place additional pressure on the groundwater supply
Groundwater Level Trend	• Updated groundwater level trends indicate that groundwater levels are declining at a faster rate even though there has been a recent decrease in municipal groundwater production in the District • Similar groundwater level declines have been observed across the region and are a measure of the reduction in groundwater storage due to groundwater withdrawals and changes in hydrology in the Sacramento River Hydrologic Region	• Future groundwater conditions for the District are projected to deteriorate, possibly at rates higher than experienced to date, especially if water demands are increased or recharge rates decrease due to changes in precipitation or land use
Groundwater Model	• The 2030 Base Case version of the County's groundwater model simulates a declining groundwater level trend in the future	• The results from the 2030 Base Case version suggest that future groundwater conditions are projected to deteriorate
Climate Change	• The District's current and projected dependence on groundwater as its sole source of water supply does not provide long-term water supply reliability or operational flexibility when climate change is considered • Cal Water needs to respond to water supply vulnerabilities associated with changes in hydrology and climate that go beyond what has been experienced historically	• Understanding and planning for potential impacts from climate change are critical to ensure that the District's water supply portfolio can be resilient to future conditions

REFERENCES

CDM, 2003a, Integrated Water and Resource Conservation Plan, Agricultural Water Demand Forecast, prepared for Butte County Department of Water and Resource Conservation, October 2003.

CDM, 2003b, Integrated Water and Resource Conservation Plan, Urban Water Demand Forecast, prepared for Butte County Department of Water and Resource Conservation, October 2003.

CDM, 2008a, Butte Basin Groundwater Model Update Phase II Report, prepared for Butte County Department of Water and Resource Conservation, March 2008.

CDM, 2008b, Butte Basin Groundwater Model Update, Base Case and Water Management Scenario Simulations, prepared for Butte County Department of Water and Resource Conservation, April 2008.

DWR, 2013, Public Review Draft California Water Plan Update 2013, accessed December 20, 2013.

West Yost, 2008, Chico-Hamilton City District Water Supply and Facilities Master Plan, May 2008.

West Yost, 2012a, Summary of Surface Water Delivery Estimate and Evaluation of Preliminary Surface Water Conveyance Projects TM, April 26, 2012.

West Yost, 2012b, Hydrogeologic Characterization and Recommendations for Site-Specific Field Studies for the Sacramento River Diversion Draft TM, December 21, 2012.

West Yost, 2013, Preliminary Alignment Study Draft TM, January 25, 2013.

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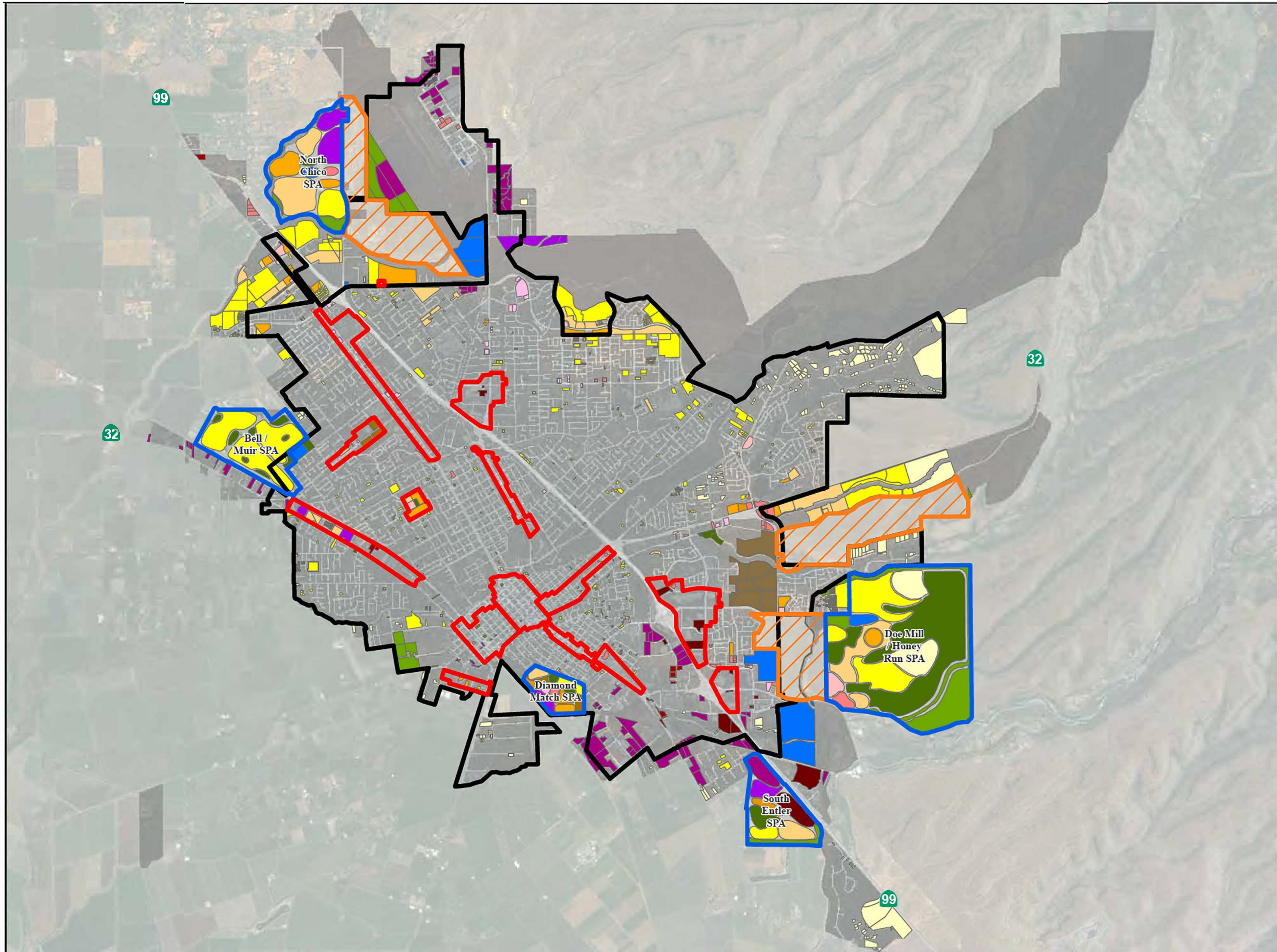


FIGURE 1

California Water Service Company
Surface Water Supply Feasibility Study

FUTURE LAND USE MAP

N

0 0.5 1
Scale in Miles

Notes
1. Vacant land calculations exclude Resource Constraint Overlay areas.

LEGEND

- Existing Land Use

Vacant Future Land Use

- Very Low Density Residential
- Low Density Residential
- Medium Density Residential
- Medium High Density Residential
- High Density Residential
- Residential Mixed Use
- Neighborhood Commercial
- Commercial Mixed Use
- Commercial Services
- Regional Commercial
- Office Mixed Use
- Industrial Office Mixed Use
- Manufacturing and Warehousing
- Public Facilities and Services
- Primary Open Space
- Secondary Open Space
- Special Mixed Use
- Chico District Service Area
- Resource Constraint Overlay
- Opportunity Site
- Special Planning Area (SPA)

WEST YOST ASSOCIATES
Consulting Engineers

Figure 2. Historical Water Production and Comparison with 2008 WSFMP Water Demand Projection

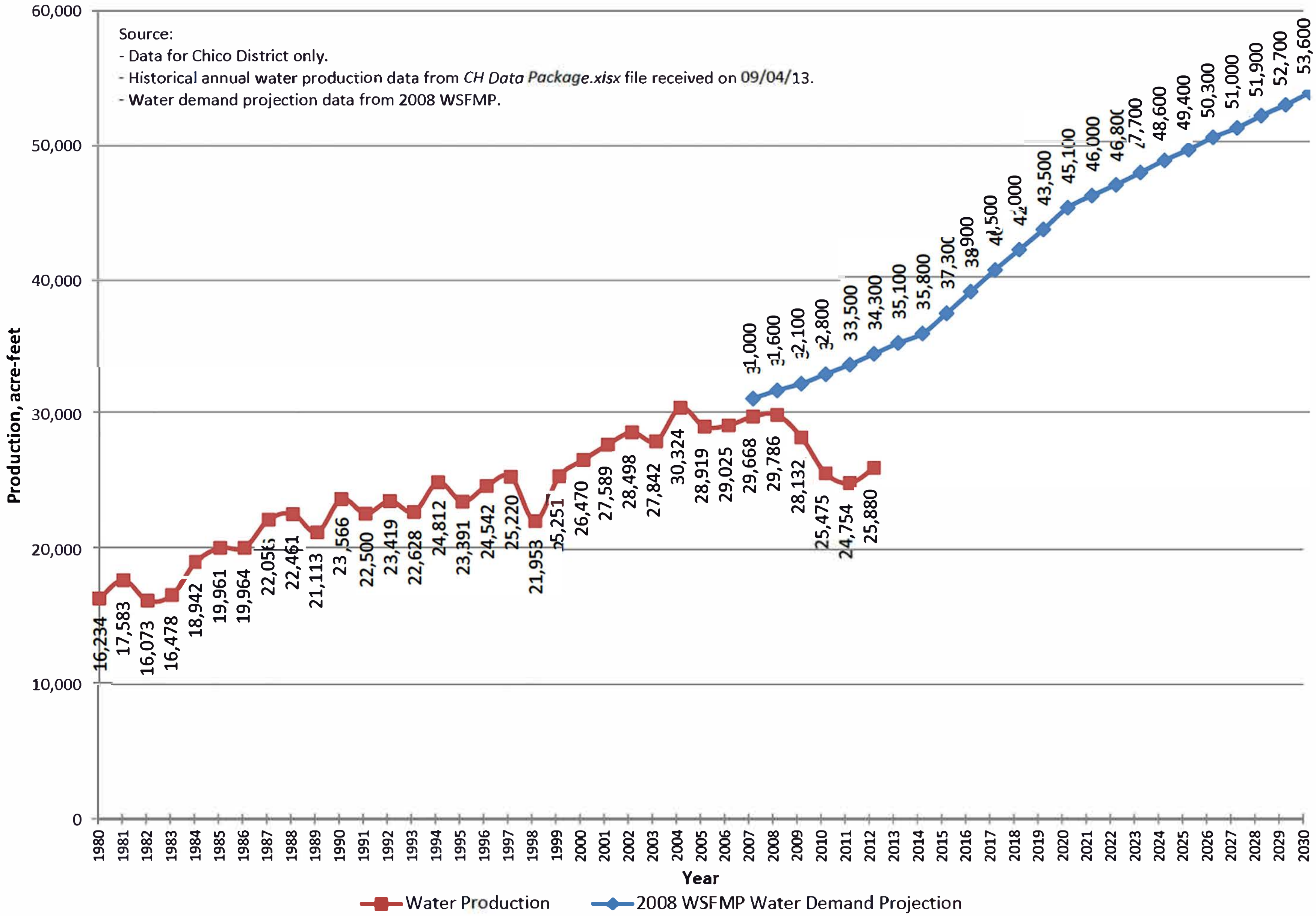
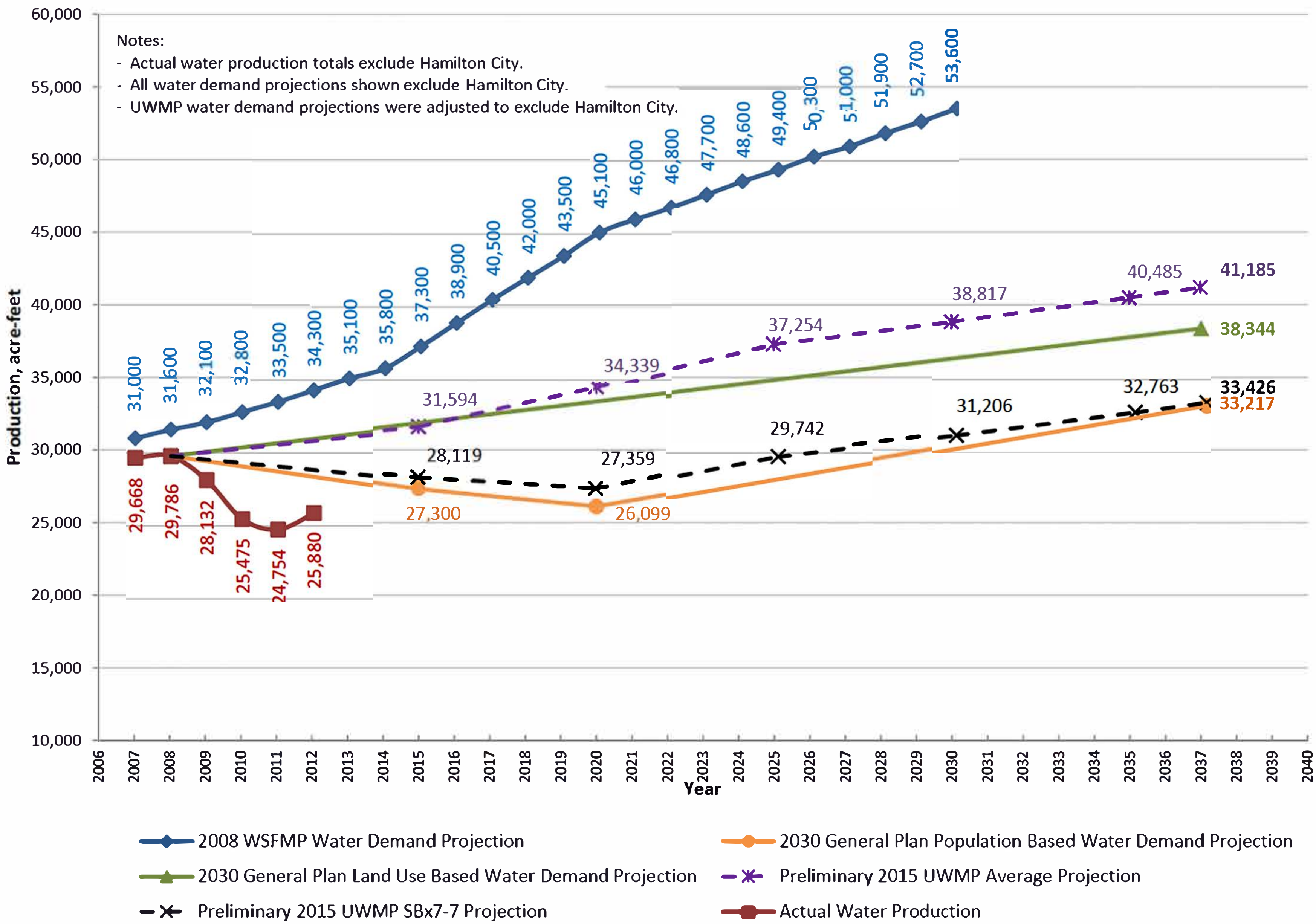


Figure 3. Updated Water Demand Projections for the Chico District



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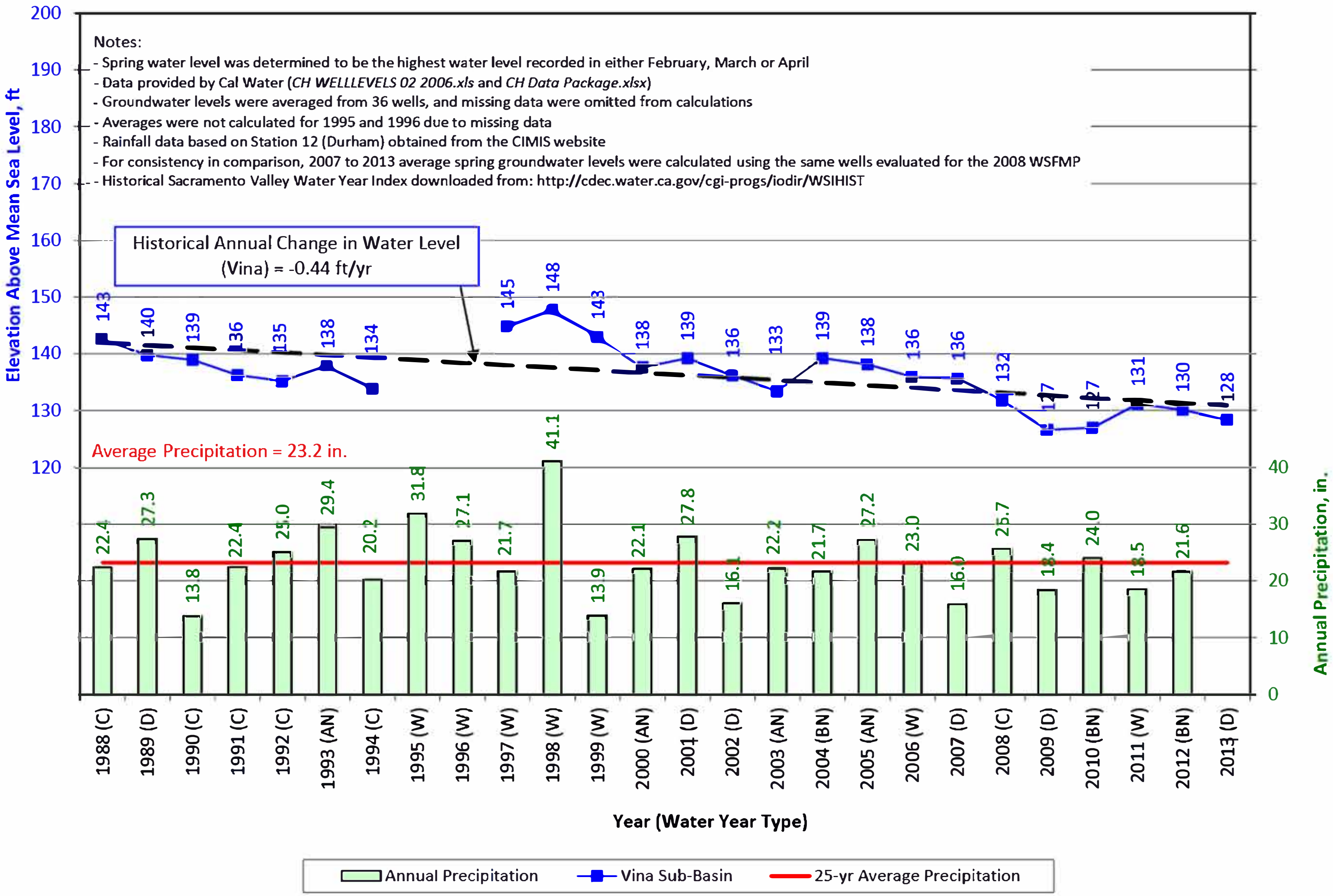
Last Revised: 01-02-14

California Water Service Company
Confidential Chico District
Surface Water Supply Feasibility Study

Figure 4. Vina Sub-Basin - Average Spring Groundwater Levels



WEST YOST ASSOCIATES
n\c\436\00-13-18\E\T2\Figures
Last Revised: 01-13-14

California Water Service Company
Confidential Chico District
Surface Water Supply Feasibility Study

Figure 5. West Butte Sub-Basin - Average Spring Groundwater Levels

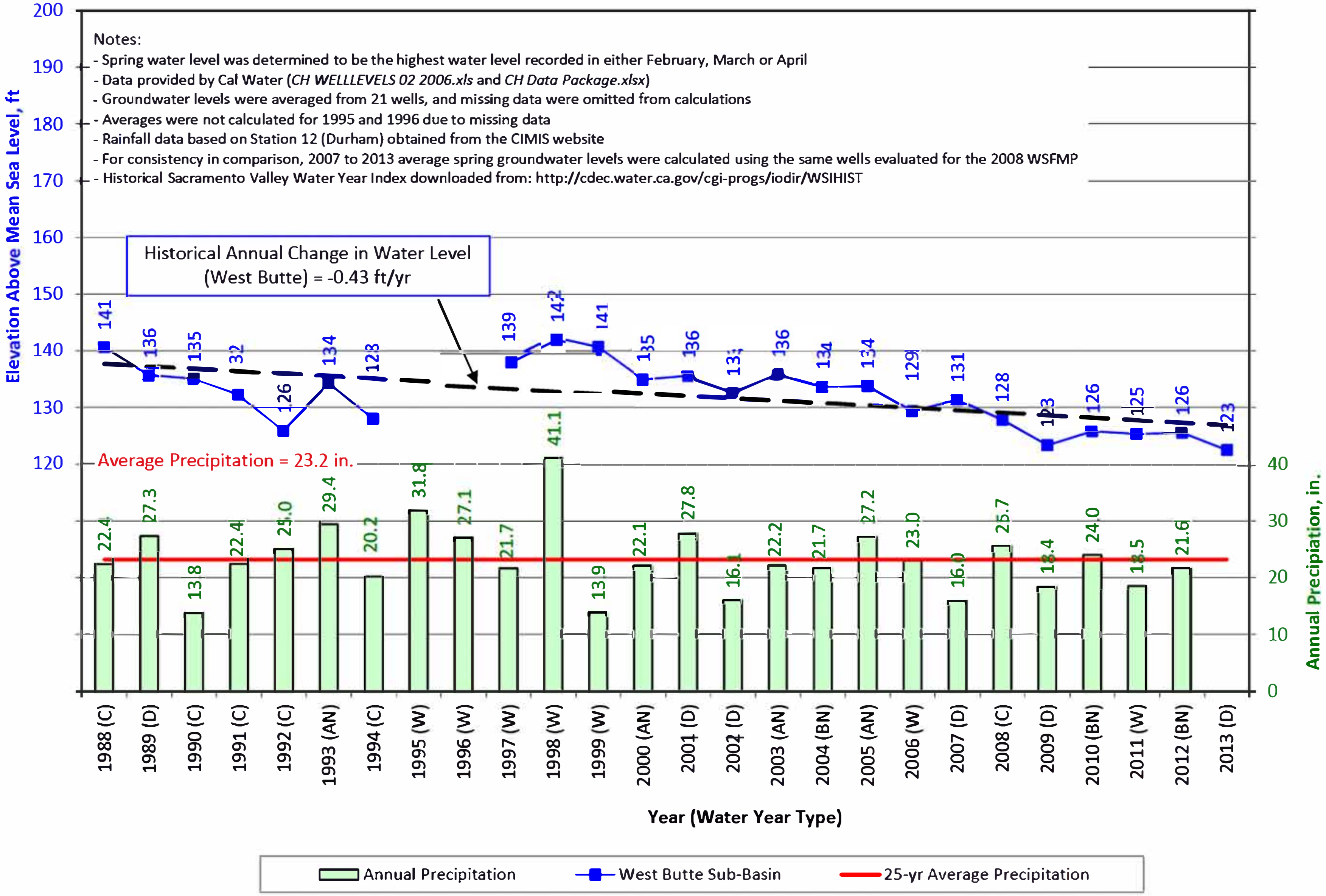


Figure 6. BCIWFM Calibration Version Simulated Groundwater Pumping in Chico

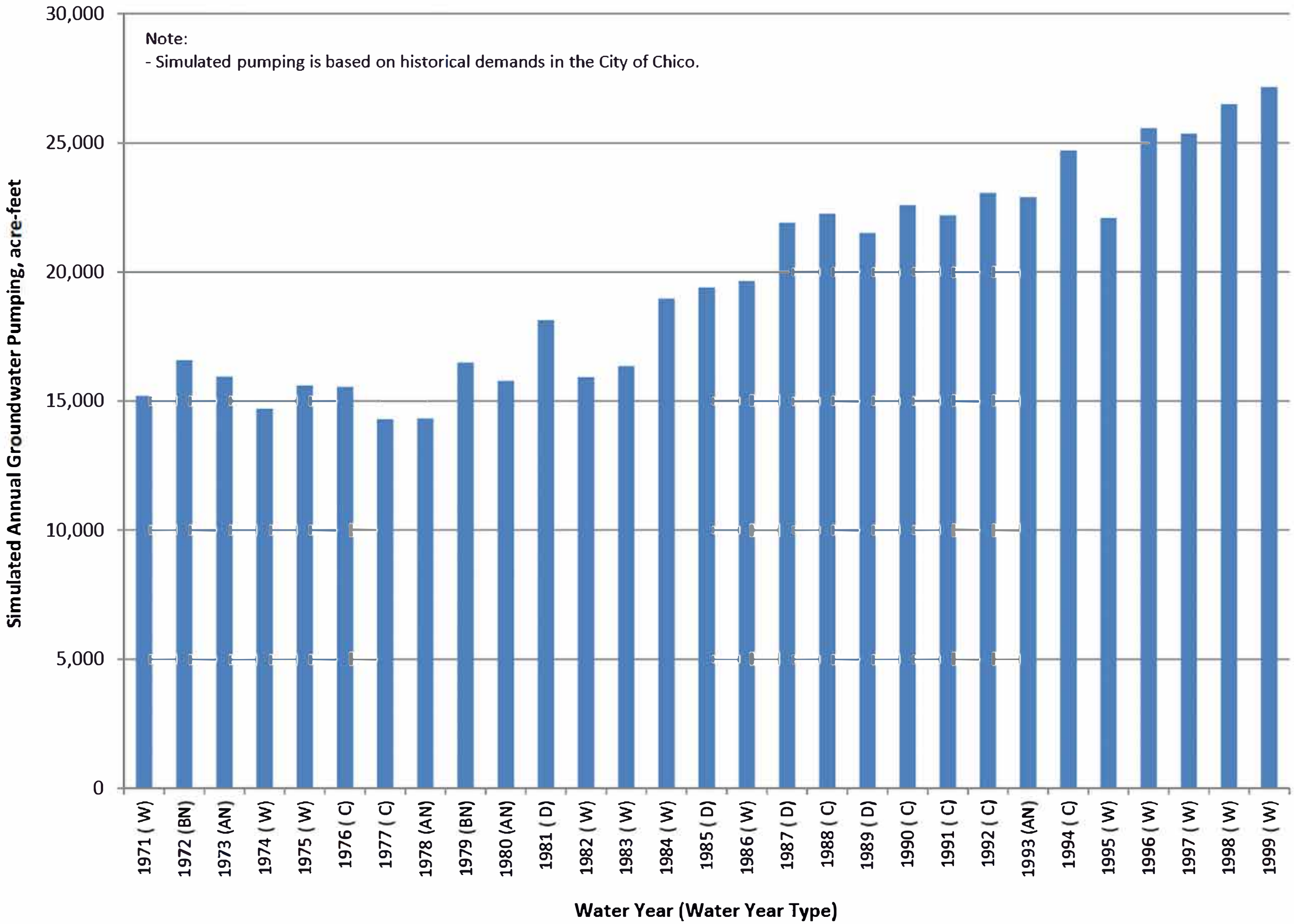
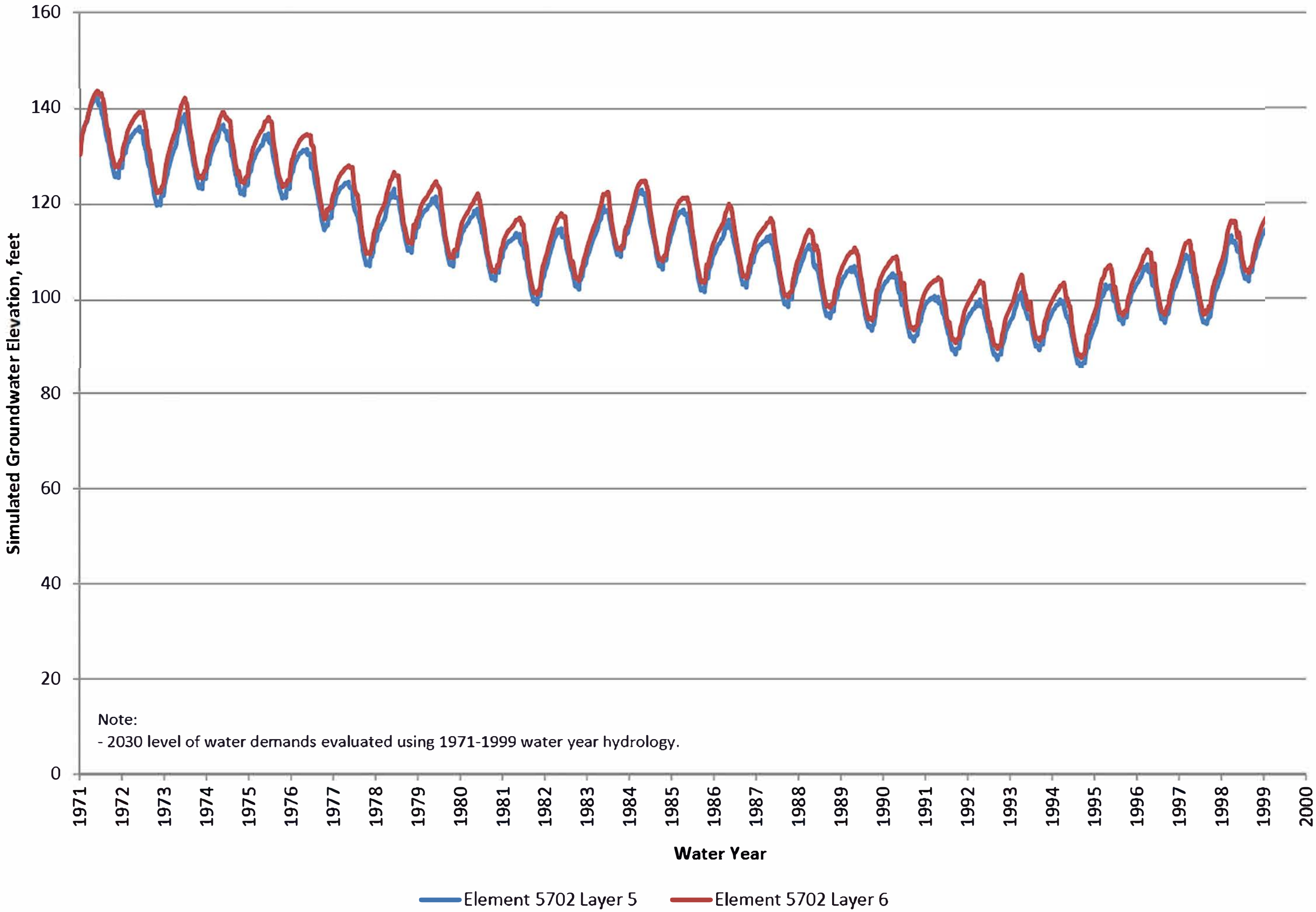


Figure 7. BCIWFM 2030 Base Case Version Simulated Groundwater Elevations - Western Chico



ATTACHMENT A

2008 WSFMP – Future Land Use Maps

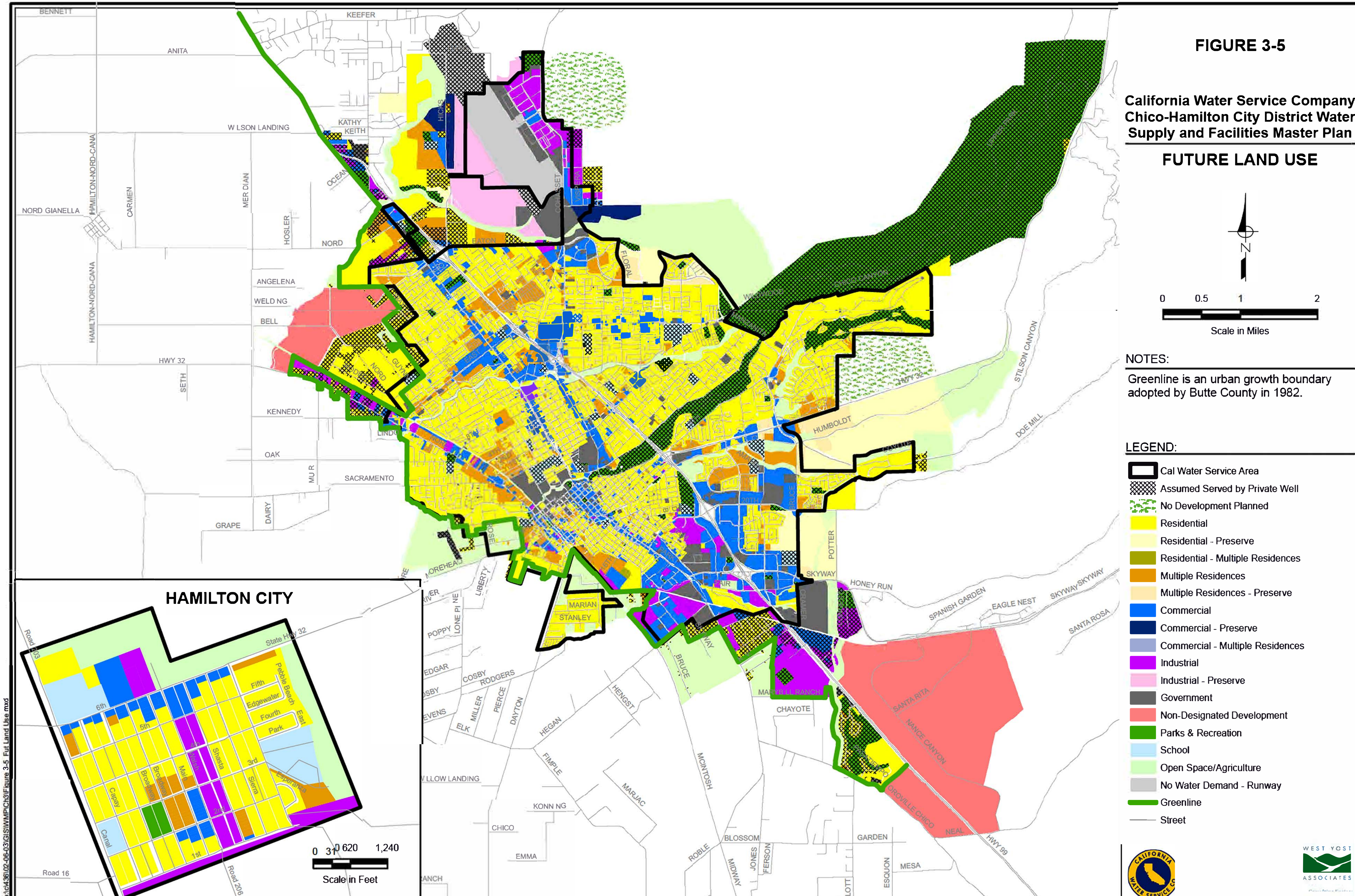


FIGURE 3-5
California Water Service Company
Chico-Hamilton City District Water
Supply and Facilities Master Plan
FUTURE LAND USE
N
0
0.5
1
2
Scale in Miles
NOTES:
Greenline is an urban growth boundary adopted by Butte County in 1982.
LEGEND:
Cal Water Service Area
Assumed Served by Private Well
No Development Planned
Residential
Residential - Preserve
Residential - Multiple Residences
Multiple Residences
Multiple Residences - Preserve
Commercial
Commercial - Preserve
Commercial - Multiple Residences
Industrial
Industrial - Preserve
Government
Non-Designated Development
Parks & Recreation
School
Open Space/Agriculture
No Water Demand - Runway
Greenline
Street
HAMILTON CITY
0
310
620
1,240
Scale in Feet
WEST YOST ASSOCIATES

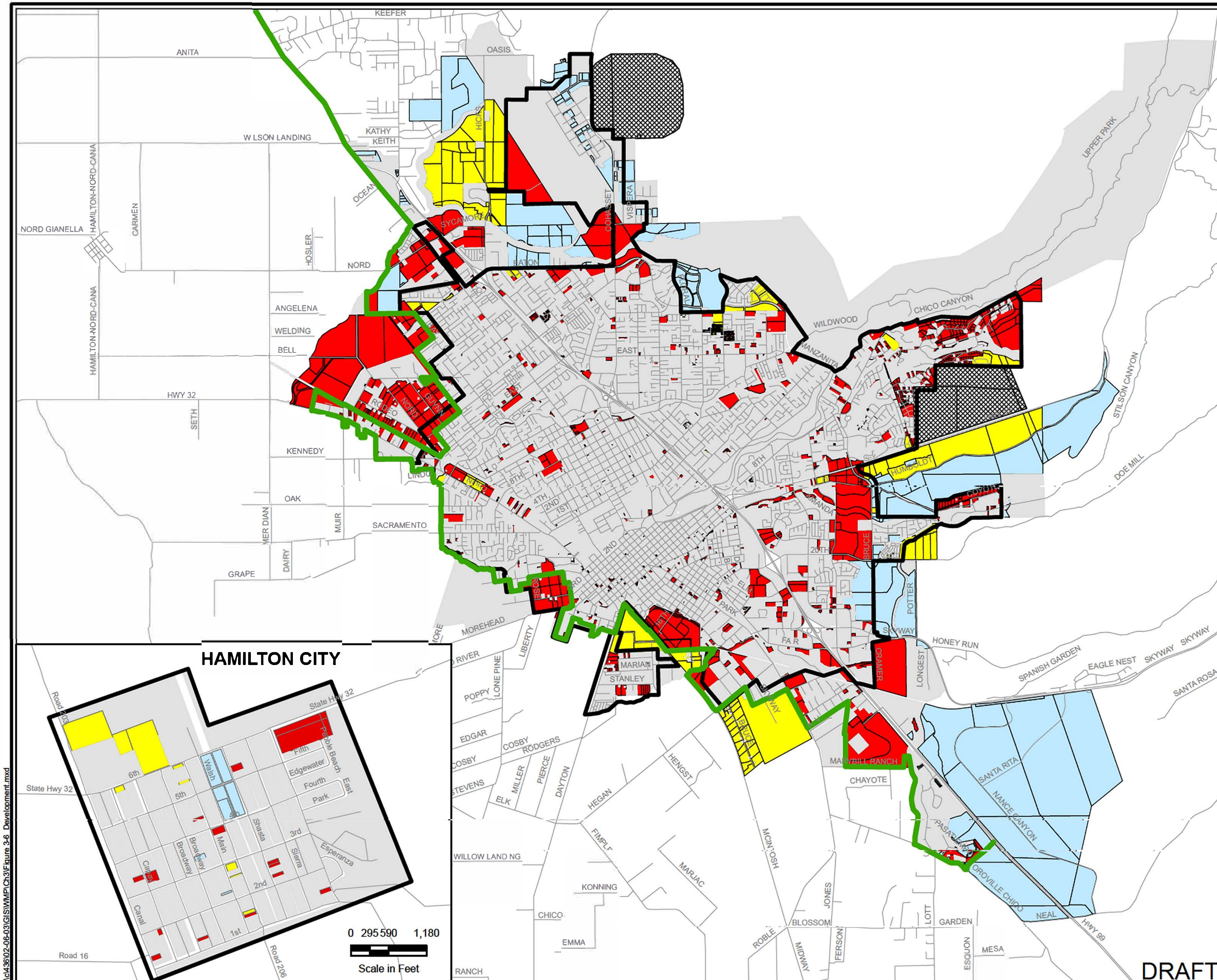


FIGURE 3-6

California Water Service Company Chico-Hamilton City District Water Supply and Facilities Master Plan

DEVELOPMENT OVER TIME

N

0 0.5 1 2

Scale in Miles

NOTES:

Greenline is an urban growth boundary adopted by Butte County in 1982.

LEGEND:

- Cal Water Service Area
- Development Starting in 2006
- Development Starting in 2010
- Development Starting in 2015
- Existing Development
- No Development Planned
- Greenline
- Street

CALIFORNIA WATER SERVICE CO.

WEST YOST ASSOCIATES Consulting Engineers

ATTACHMENT B

2008 WSFMP – Groundwater Level Trends for Chico District Wells in the Vina and West Butte Sub-Basins

Figure 4-3. Vina Sub-Basin - Average Spring Groundwater Levels

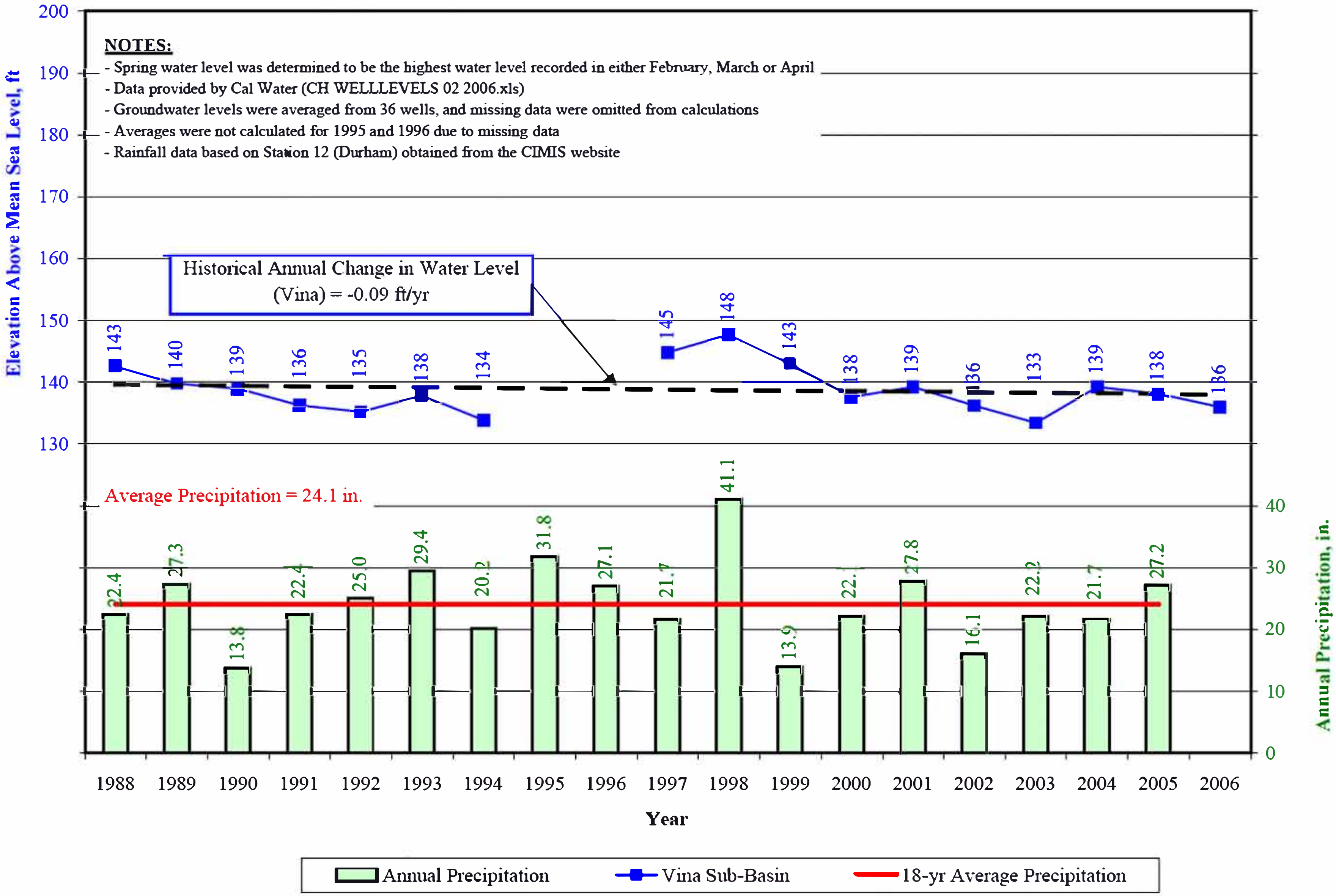
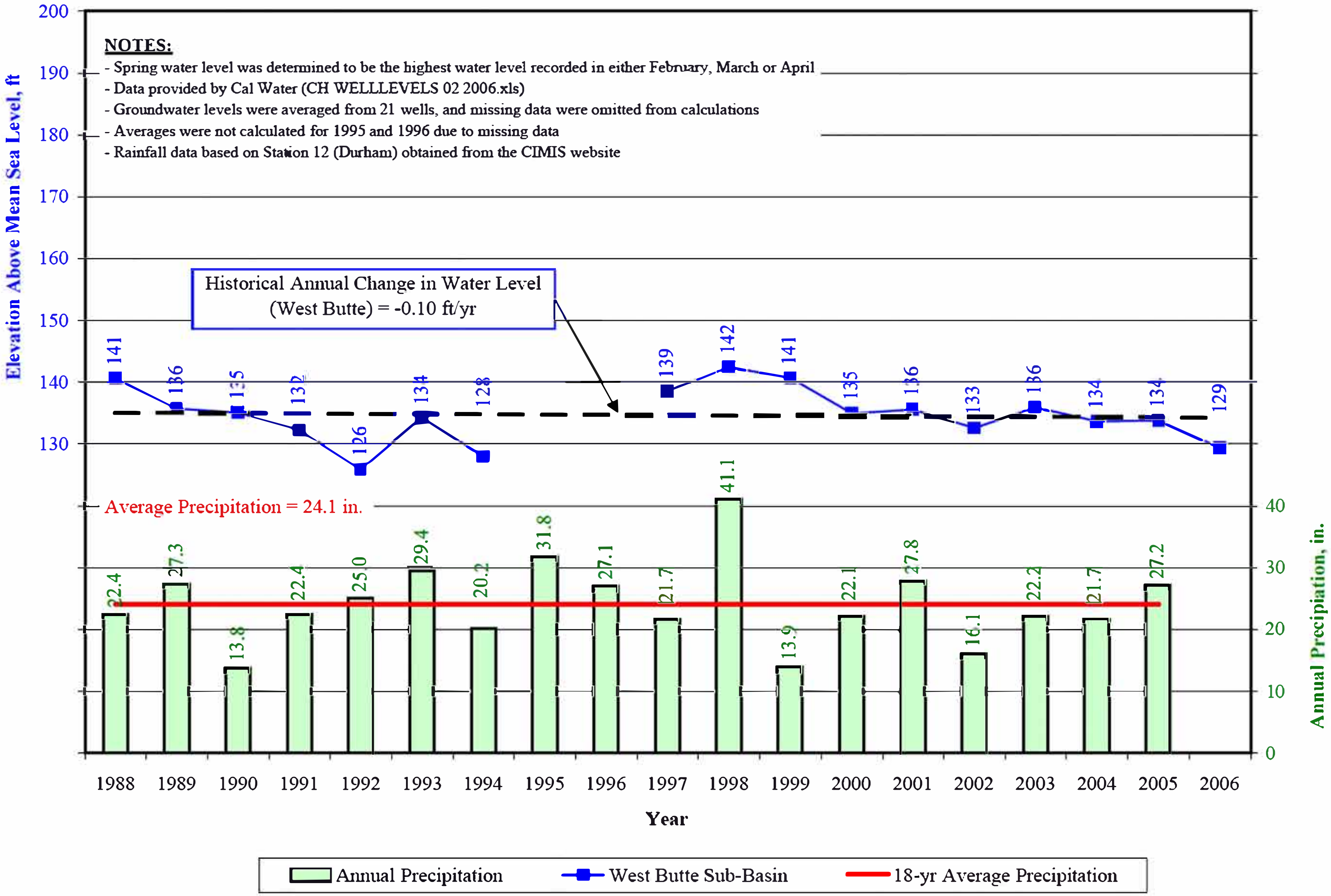


Figure 4-11. West Butte Sub-Basin - Average Spring Groundwater Level Hydrograph



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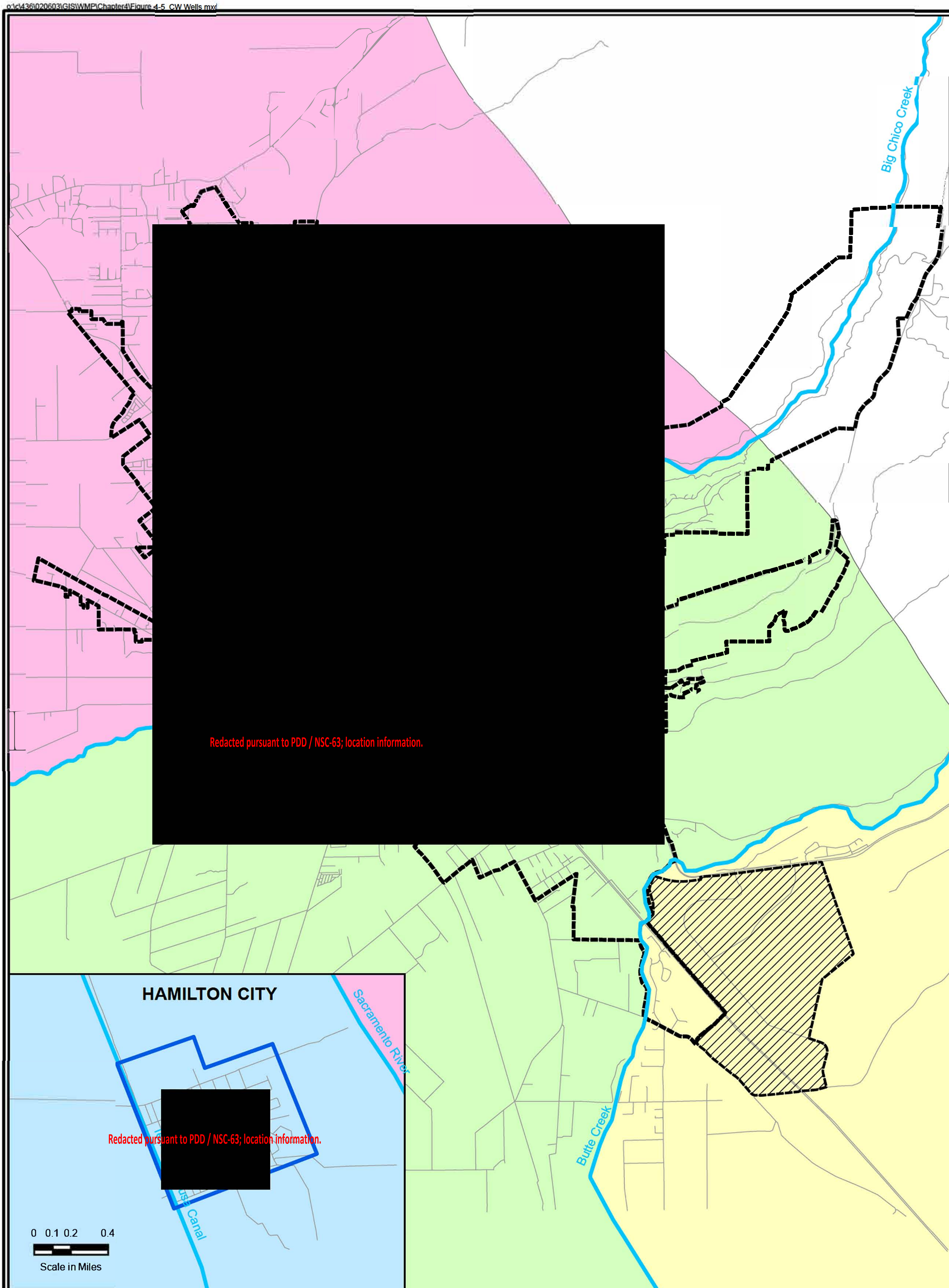

LEGEND

- Cal Water Well with Declines > 0.75 ft/year
- Other Cal Water Wells
- Major Rivers
- Chico Sphere of Influence
- Hamilton City Service Area
- Blakely & Swartz Development
- Street
- East Butte Sub-Basin
- Vina Sub-Basin
- West Butte Sub-Basin
- Corning Sub-Basin

N

0 0.3 0.6 1.2
Scale in Miles

FIGURE 4-5

California Water Service Company
Chico-Hamilton City District Water Supply and Facilities Master Plan

WATER LEVEL DECLINES GREATER THAN 0.75 ft/year

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ATTACHMENT C

Updated Groundwater Level Trends for Selected DWR Wells in the Vina and West Butte Sub-Basins

o:\c\436\020603\GIS\WMP\Chapter4\Figure 4-4_DWR Wells.mxd

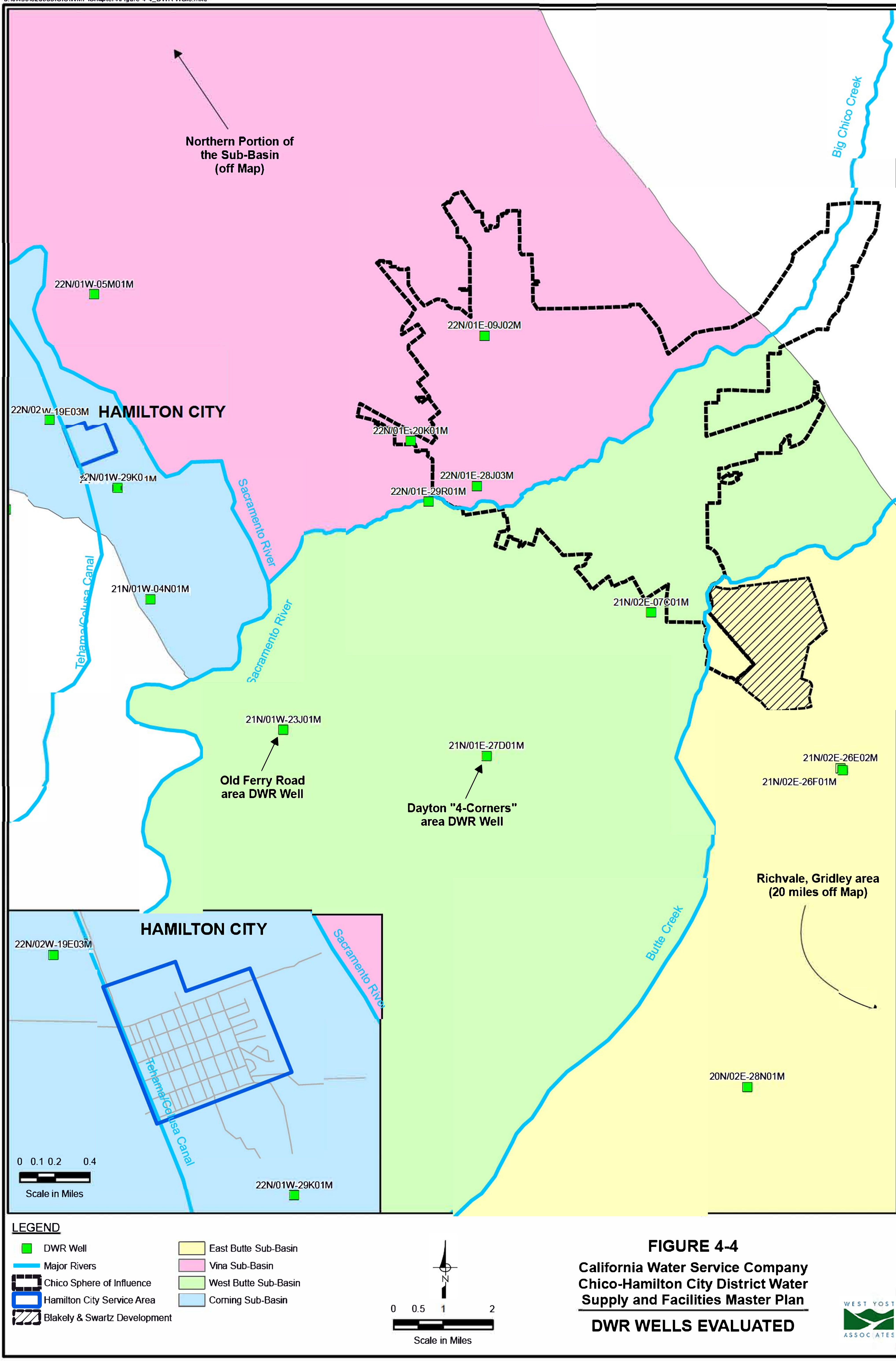
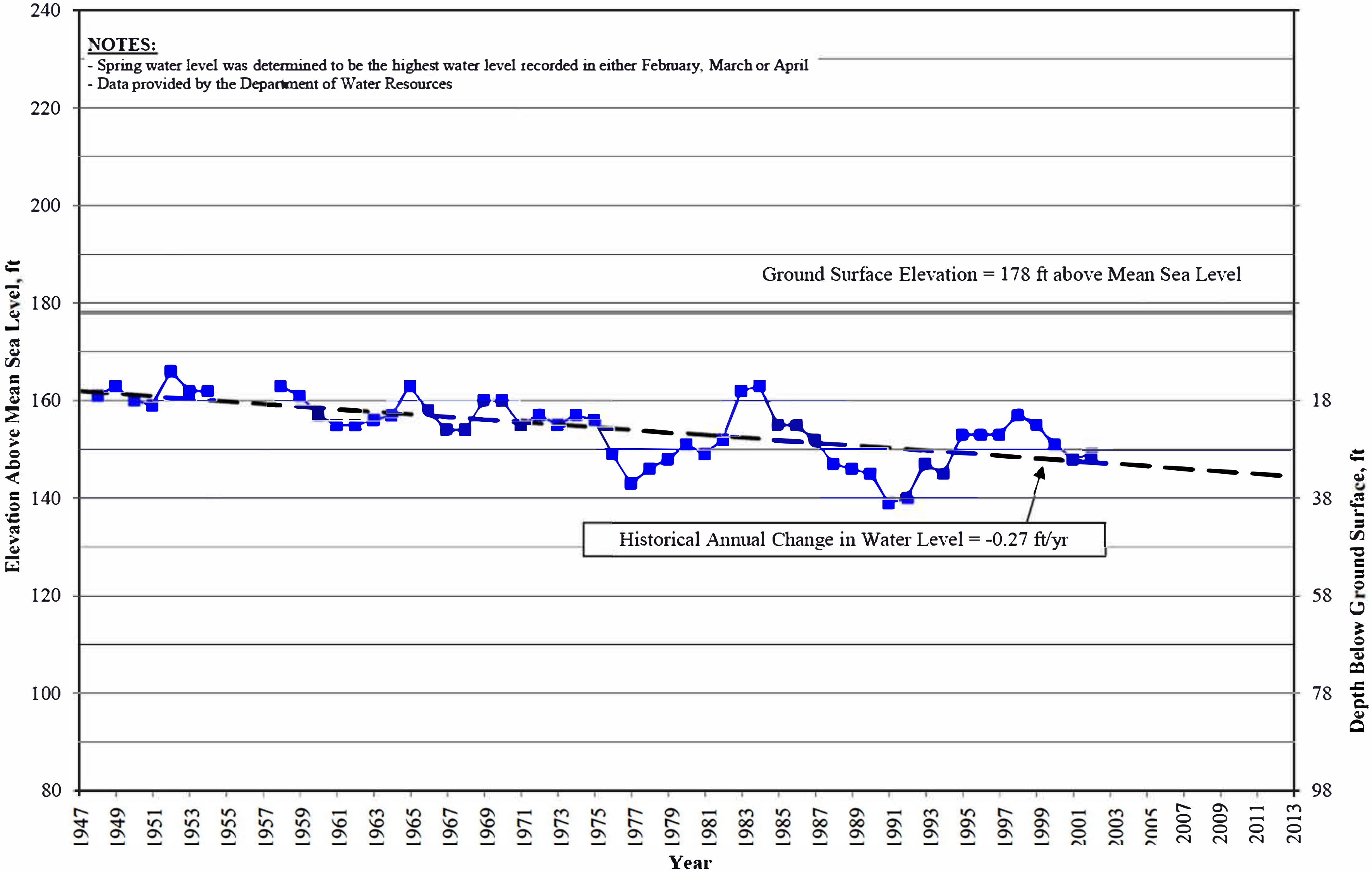


FIGURE 4-4

California Water Service Company
Chico-Hamilton City District Water Supply and Facilities Master Plan

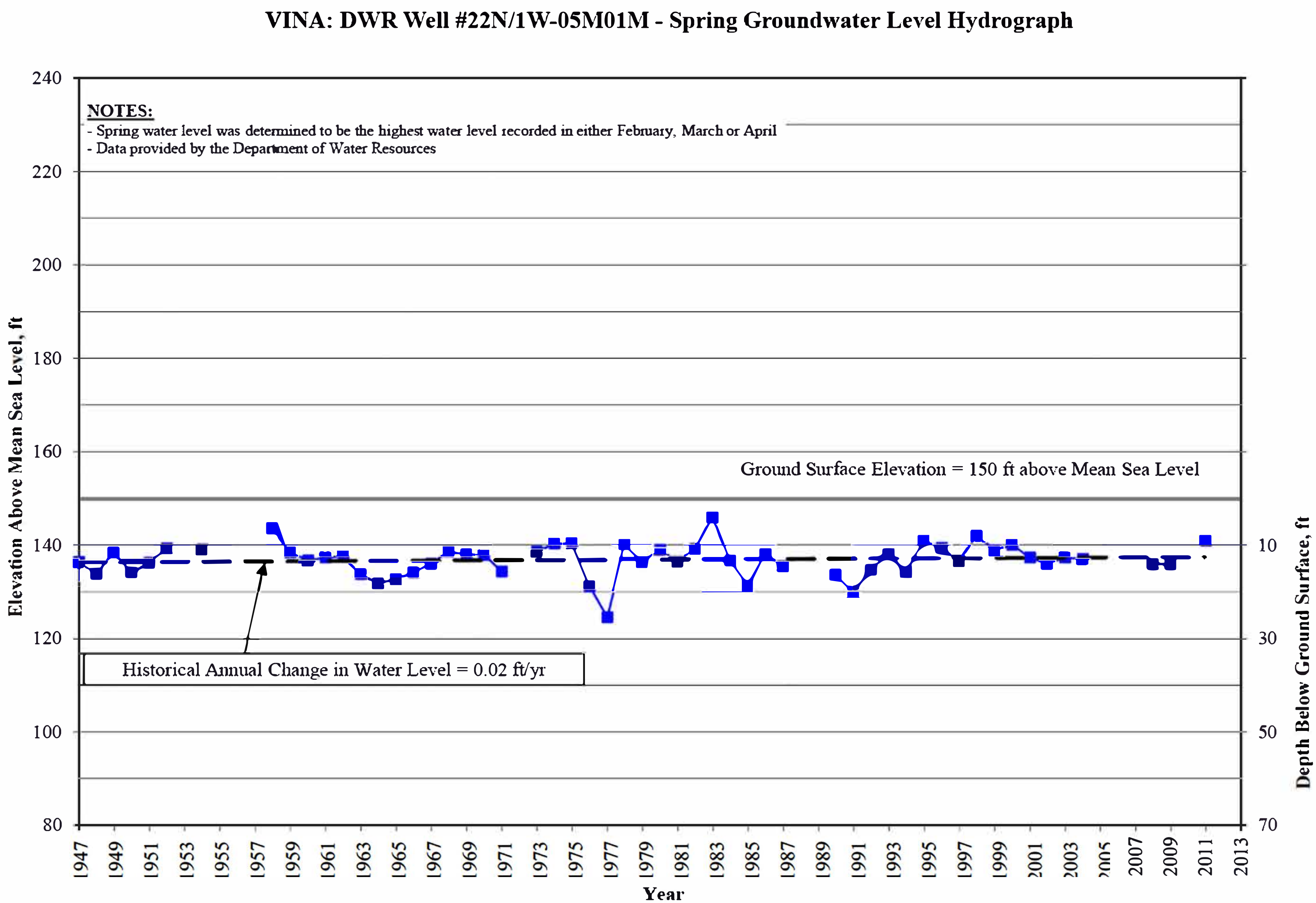
DWR WELLS EVALUATED

VINA: DWR Well #22N/1E-09J02M - Spring Groundwater Level Hydrograph



West Yost Associates
n:\c\436\00-13-18\E\T2CH-Depth to GW_2
Last Revised: 12/06/13

California Water Service Company
Confidential Chico District
Surface Water Supply Feasibility Study


VINA: DWR Well #22N/1W-05M01M - Spring Groundwater Level Hydrograph
NOTES:
- Spring water level was determined to be the highest water level recorded in either February, March or April
- Data provided by the Department of Water Resources
Ground Surface Elevation = 150 ft above Mean Sea Level
Historical Annual Change in Water Level = 0.02 ft/yr
Elevation Above Mean Sea Level, ft
Depth Below Ground Surface, ft
Year
240
220
200
180
160
140
120
100
80
10
30
50
70
1947
1949
1951
1953
1955
1957
1959
1961
1963
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1977
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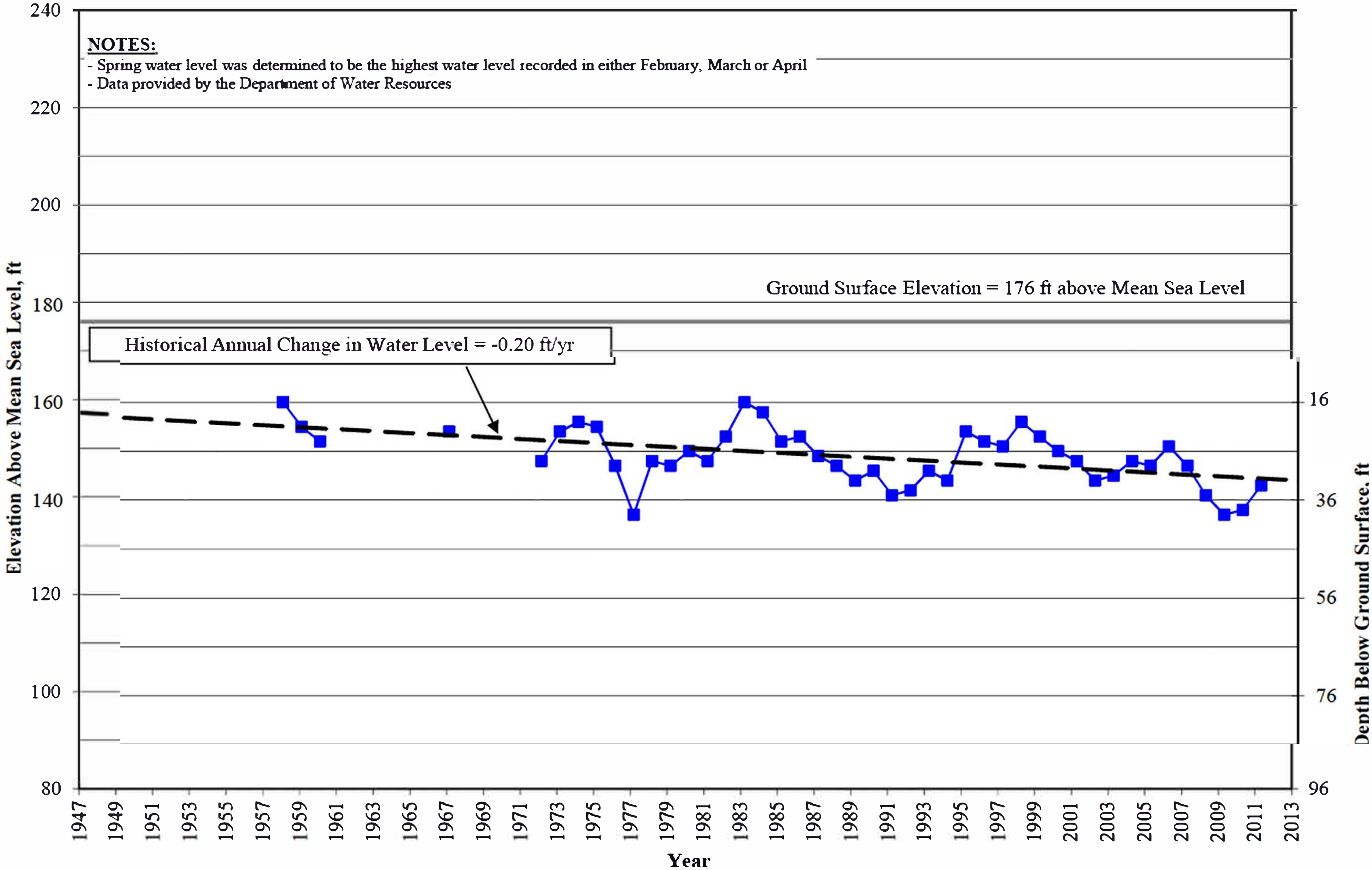
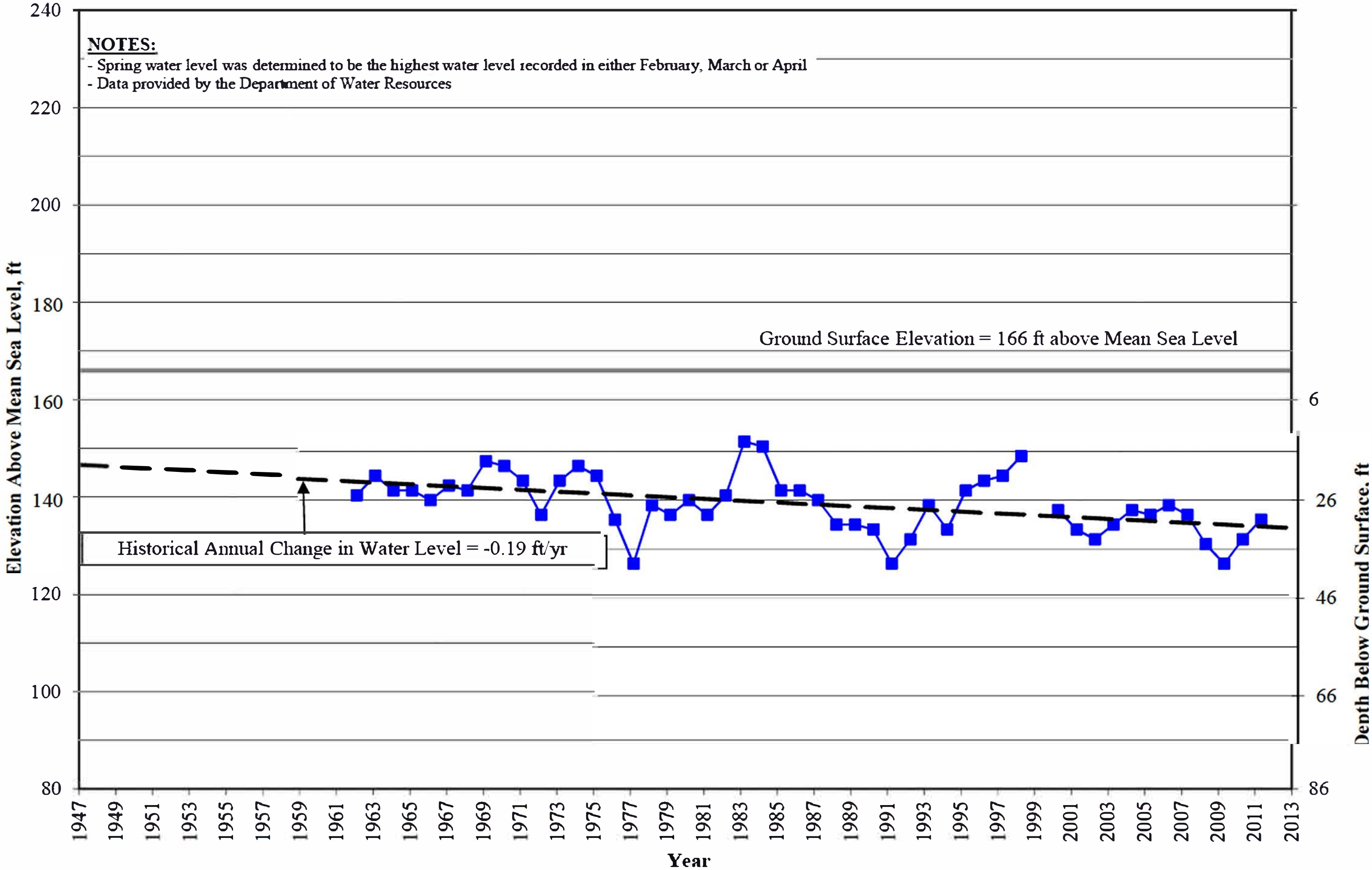
1999
2001
2003
2005
2007
2009
2011
2013

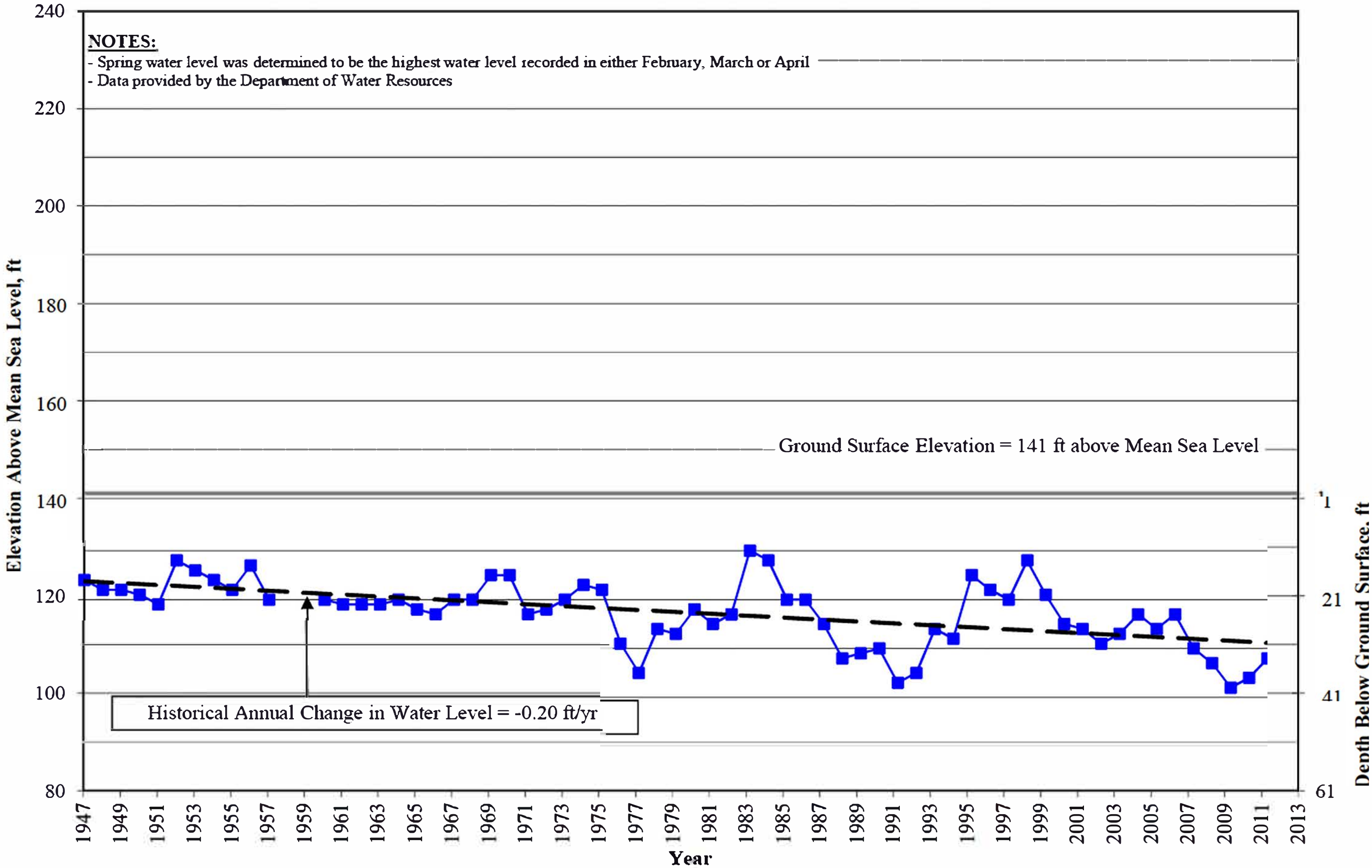
VINA: DWR Well #22N/1E-28J03M - Spring Groundwater Level Hydrograph



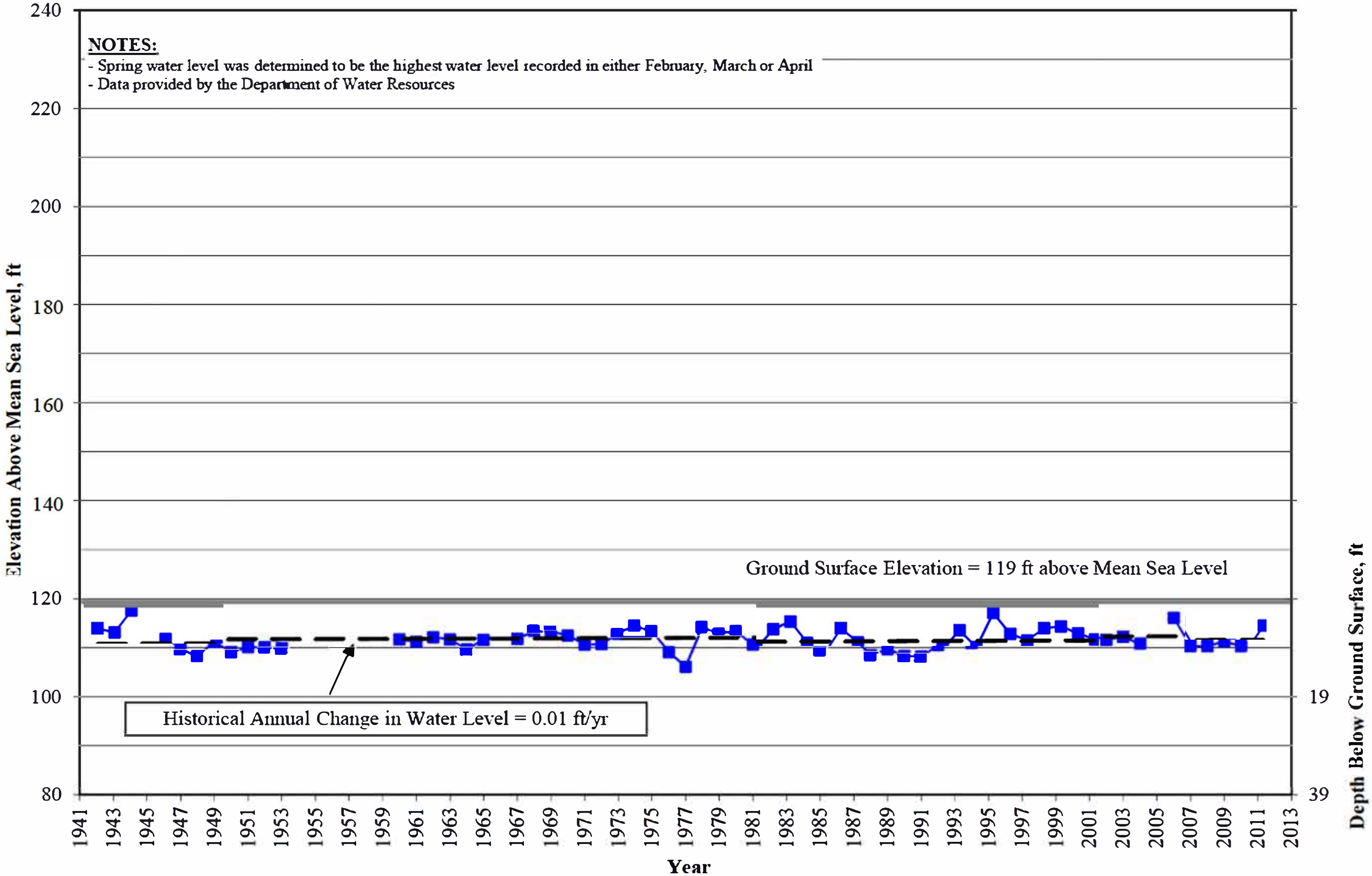
VINA: DWR Well #22N/1E-20K01M - Spring Groundwater Level Hydrograph



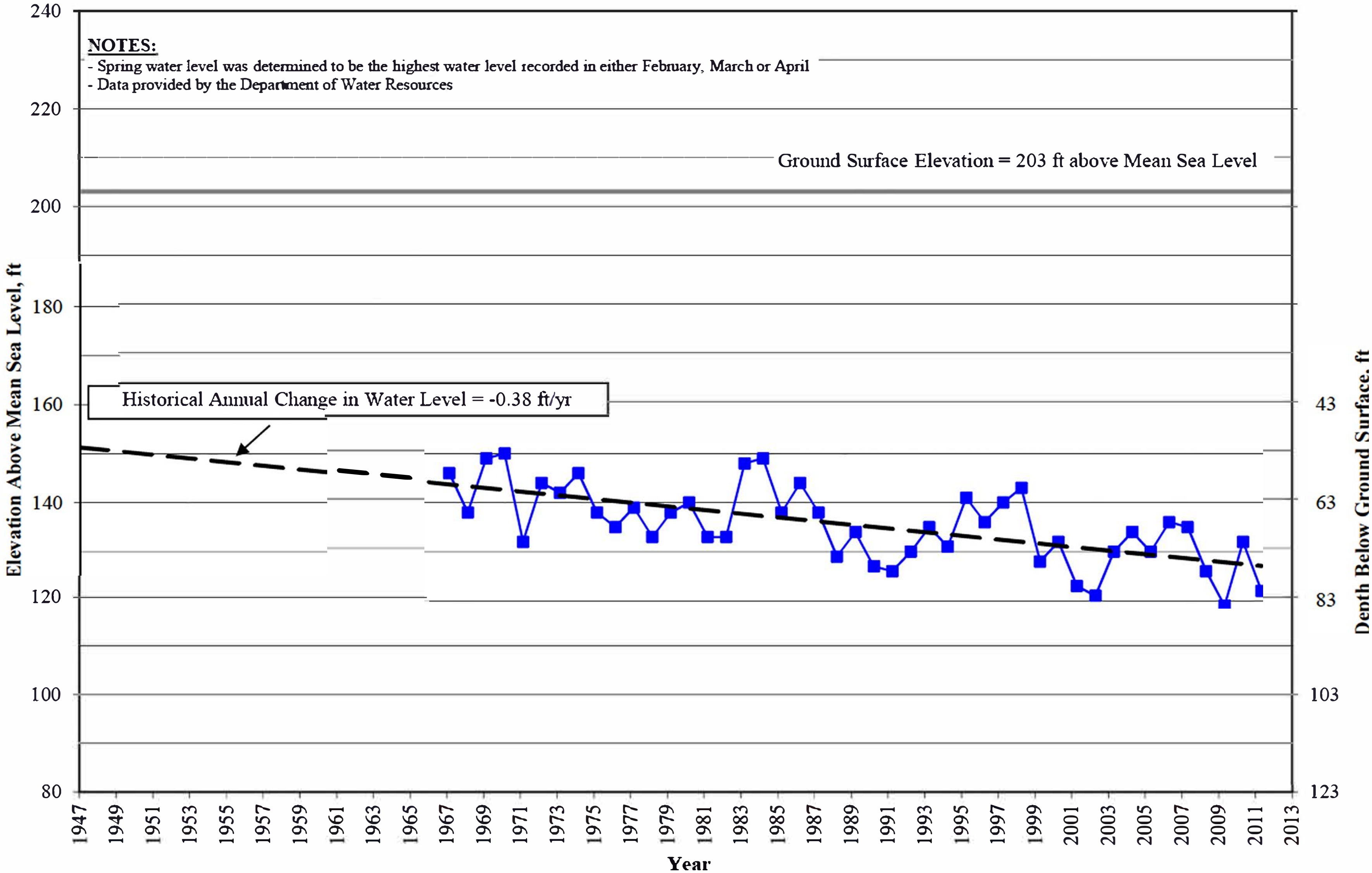
WEST BUTTE: DWR Well #21N/1E-27D01M - Spring Groundwater Level Hydrograph



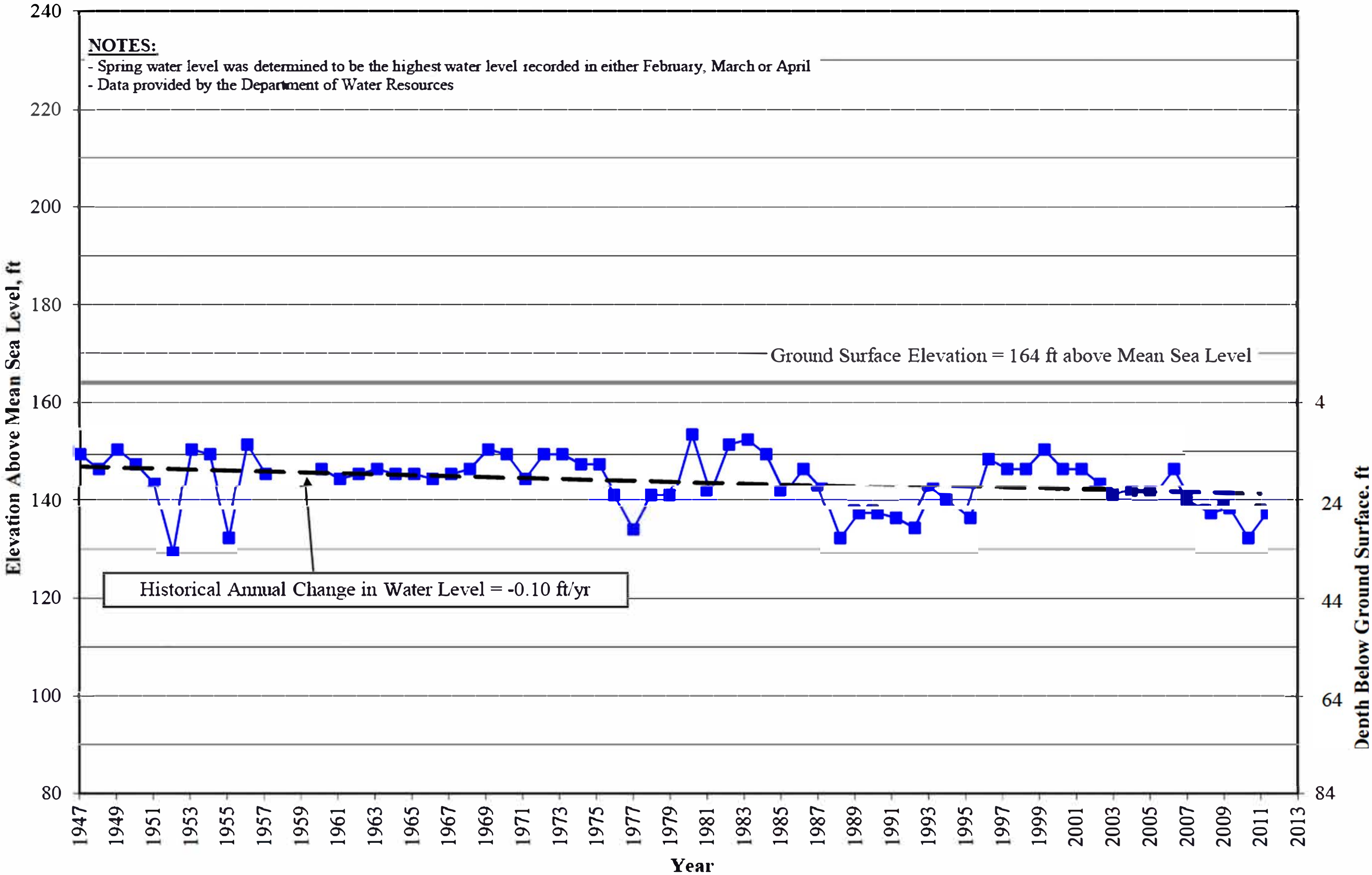
WEST BUTTE: DWR Well #21N/1W-23J01M - Spring Groundwater Level Hydrograph



WEST BUTTE: DWR Well #21N/2E-07C01M - Spring Groundwater Level Hydrograph

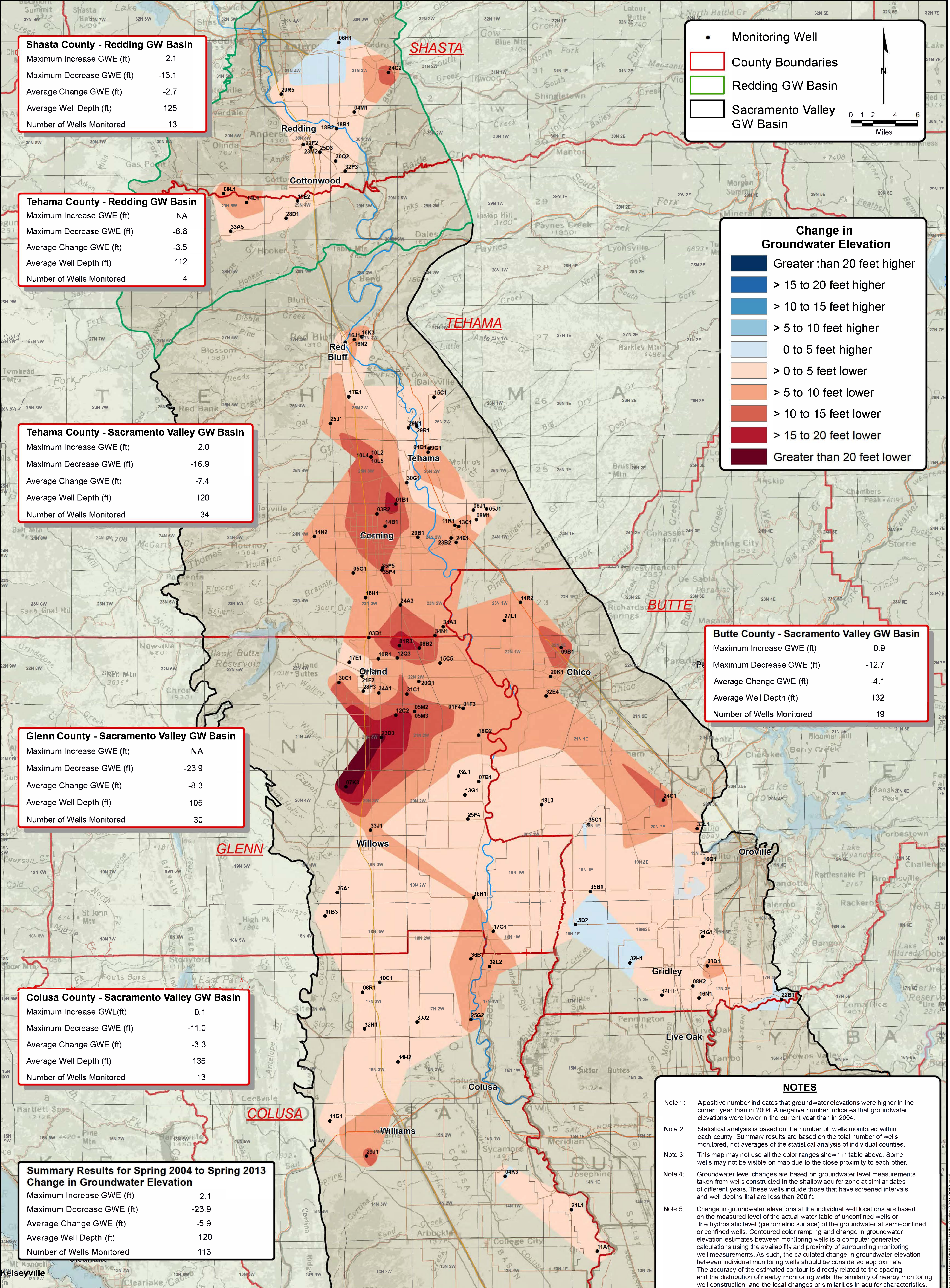


WEST BUTTE: DWR Well #22N/1E-29R01M - Spring Groundwater Level Hydrograph



ATTACHMENT D

DWR Northern Sacramento Valley – Change in Groundwater Elevation Maps



Shasta County - Redding GW Basin

Maximum Increase GWE (ft)	2.1
Maximum Decrease GWE (ft)	-13.1
Average Change GWE (ft)	-2.7
Average Well Depth (ft)	125
Number of Wells Monitored	13

Tehama County - Redding GW Basin

Maximum Increase GWE (ft)	NA
Maximum Decrease GWE (ft)	-6.8
Average Change GWE (ft)	-3.5
Average Well Depth (ft)	112
Number of Wells Monitored	4

Tehama County - Sacramento Valley GW Basin

Maximum Increase GWE (ft)	2.0
Maximum Decrease GWE (ft)	-16.9
Average Change GWE (ft)	-7.4
Average Well Depth (ft)	120
Number of Wells Monitored	34

Butte County - Sacramento Valley GW Basin

Maximum Increase GWE (ft)	0.9
Maximum Decrease GWE (ft)	-12.7
Average Change GWE (ft)	-4.1
Average Well Depth (ft)	132
Number of Wells Monitored	19

Glenn County - Sacramento Valley GW Basin

Maximum Increase GWE (ft)	NA
Maximum Decrease GWE (ft)	-23.9
Average Change GWE (ft)	-8.3
Average Well Depth (ft)	105
Number of Wells Monitored	30

Colusa County - Sacramento Valley GW Basin

Maximum Increase GWL(ft)	0.1
Maximum Decrease GWE (ft)	-11.0
Average Change GWE (ft)	-3.3
Average Well Depth (ft)	135
Number of Wells Monitored	13

Summary Results for Spring 2004 to Spring 2013 Change in Groundwater Elevation

Maximum Increase GWE (ft)	2.1
Maximum Decrease GWE (ft)	-23.9
Average Change GWE (ft)	-5.9
Average Well Depth (ft)	120
Number of Wells Monitored	113

NOTES

Note 1: A positive number indicates that groundwater elevations were higher in the current year than in 2004. A negative number indicates that groundwater elevations were lower in the current year than in 2004.

Note 2: Statistical analysis is based on the number of wells monitored within each county. Summary results are based on the total number of wells monitored, not averages of the statistical analysis of individual counties.

Note 3: This map may not use all the color ranges shown in table above. Some wells may not be visible on map due to the close proximity to each other.

Note 4: Groundwater level changes are based on groundwater level measurements taken from wells constructed in the shallow aquifer zone at similar dates of different years. These wells include those that have screened intervals and well depths that are less than 200 ft.

Note 5: Change in groundwater elevations at the individual well locations are based on the measured level of the actual water table of unconfined wells or the hydrostatic level (piezometric surface) of the groundwater at semi-confined or confined wells. Contoured color ramping and change in groundwater elevation estimates between monitoring wells is a computer generated calculations using the availability and proximity of surrounding monitoring well measurements. As such, the calculated change in groundwater elevation between individual monitoring wells should be considered approximate. The accuracy of the estimated contour is directly related to the spacing and the distribution of nearby monitoring wells, the similarity of nearby monitoring well construction, and the local changes or similarities in aquifer characteristics.

Note 6: GWE - Groundwater Elevation
bgs - below ground surface

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
NORTHERN REGION OFFICE
2440 Main Street
Red Bluff, California 96080
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NORTHERN SACRAMENTO VALLEY CHANGE IN GROUNDWATER ELEVATION MAP SPRING 2004 TO SPRING 2013

SHALLOW AQUIFER ZONE

(Well depths less than 200 ft bgs)

PLATE 1S-B

Date: July 2013

BY: G. Gordon

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Red Bluff, California 96080
(530) 529-7300

NORTHERN SACRAMENTO VALLEY CHANGE IN GROUNDWATER ELEVATION MAP SPRING 2004 TO SPRING 2013

DEEP AQUIFER ZONE

(Wells with screen intervals and well depths generally greater than 600 ft bgs)

PLATE 1D-B

Date: July 2013

BY: G. Gordon

http://www.water.ca.gov/groundwater/data_and_monitoring/northern_region/GroundwaterLevel/gw_level_monitoring.cfm

Shasta County - Redding GW Basin

Maximum Increase GWE (ft)	13.1
Maximum Decrease GWE (ft)	-7.0
Average Change GWE (ft)	-0.1
Average Well Depth (ft)	282
Number of Wells Monitored	9

Tehama County - Redding GW Basin

Maximum Increase GWE (ft)	NA
Maximum Decrease GWE (ft)	-7.3
Average Change GWE (ft)	-6.9
Average Well Depth (ft)	424
Number of Wells Monitored	5

Tehama County - Sacramento Valley GW Basin

Maximum Increase GWE (ft)	NA
Maximum Decrease GWE (ft)	-16.5
Average Change GWE (ft)	-8.8
Average Well Depth (ft)	402
Number of Wells Monitored	12

Butte County - Sacramento Valley GW Basin

Maximum Increase GWE (ft)	0.3
Maximum Decrease GWE (ft)	-27.9
Average Change GWE (ft)	-8.1
Average Well Depth (ft)	444
Number of Wells Monitored	16

Glenn County - Sacramento Valley GW Basin

Maximum Increase GWE (ft)	NA
Maximum Decrease GWE (ft)	-44.9
Average Change GWE (ft)	-13.8
Average Well Depth (ft)	426
Number of Wells Monitored	24

Colusa County - Sacramento Valley GW Basin

Maximum Increase GWL(ft)	0
Maximum Decrease GWE (ft)	-24.6
Average Change GWE (ft)	-7.4
Average Well Depth (ft)	413
Number of Wells Monitored	17

Summary Results for Spring 2004 to Spring 2013 Change in Groundwater Elevation

Maximum Increase GWE (ft)	13.1
Maximum Decrease GWE (ft)	-44.9
Average Change GWE (ft)	-8.7
Average Well Depth (ft)	408
Number of Wells Monitored	83

NOTES

Note 1: A positive number indicates that groundwater elevations were higher in the current year than in 2004. A negative number indicates that groundwater elevations were lower in the current year than in 2004.

Note 2: Statistical analysis is based on the number of wells monitored within each county. Summary results are based on the total number of wells monitored, not averages of the statistical analysis of individual counties.

Note 4: Groundwater level changes are based on groundwater level measurements taken from wells constructed in the intermediate aquifer zone at similar dates of different years. These wells include those that have screened intervals and well depths that are generally greater than 200 ft and less than 600 ft.

Note 5: Change in groundwater elevations are based on the actual measured levels of the hydrostatic level (piezometric surface) of the groundwater at individual well locations. Contoured color ramping and change in groundwater elevation estimates between monitoring wells is a computer generated calculation using the availability and proximity of surrounding monitoring well measurements. As such, the calculated change in groundwater elevation between individual monitoring wells should be considered approximate. The accuracy of the estimated contour is directly related to the spacing and the distribution of nearby monitoring wells, the similarity of nearby monitoring well construction, and the local changes or similarities in aquifer characteristics.

Note 6: GWE - Groundwater Elevation
bgs - below ground surface

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NORTHERN SACRAMENTO VALLEY CHANGE IN GROUNDWATER ELEVATION MAP SPRING 2004 TO SPRING 2013

INTERMEDIATE AQUIFER ZONE

(Wells generally greater than 200 ft deep and less than 600 ft deep bgs)

PLATE 1I-B

Date: July 2013

BY: G. Gordon

Path: R:\Sections\DCM\CHANGE_MAP\2013\2004_2013_SpringArcMap\ExpIntermediate_Wells_Spring 2004-2013.mxd

WEST YOST
ASSOCIATES
Consulting Engineers

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TECHNICAL MEMORANDUM

DATE: February 13, 2015

Project No.: 436-10-14-19
SENT VIA: EMAIL

TO: Peter Bonacich, Cal Water

CC: Tom Salzano, Cal Water
Tim Treloar, Cal Water
Ted Coughlin, Cal Water
Michael Pembroke, Cal Water
Vickie Newlin, Butte County

PROFESSIONAL GEOLOGIST
KENNETH L. LOY
NO. 7008
EXP. 11/30/15
STATE OF CALIFORNIA

FROM: Ken Loy, P.G. #7008
Amy Kwong, R.C.E. #73213

REVIEWED BY: Charles Duncan, R.C.E. #55498

SUBJECT: Analysis of Chico District Water Demand Scenarios using the Butte County Integrated Water Flow Model

This technical memorandum (TM) describes West Yost Associates' evaluation of projected groundwater level changes due to varying levels of municipal water demand for groundwater in the California Water Service Company's (Cal Water) Chico District. This evaluation was performed using the current version of the Butte County's (County) Butte County Integrated Water Flow Model (BCIWFM). The following three water demand scenarios were evaluated in the BCIWFM:

- Current (2013) water demands met by groundwater;
- Future (2030) water demands met by groundwater; and
- Future (2030) water demands met by treated surface water and groundwater.

This evaluation also included a limited sensitivity analysis to assess the sensitivity of groundwater levels to changes in the Chico District's groundwater demands and increases in the use of groundwater for irrigated agriculture.

BACKGROUND

In 2011, West Yost Associates (West Yost) began a study to evaluate the feasibility of utilizing Butte County's State Water Project (SWP) long-term contract supply (Table A supply) as a supplemental drinking water supply for Cal Water's Chico District (District) service area in the City of Chico (City). If feasible, this proposed project could provide for the delivery of surface water supplies to the Chico District to be used conjunctively with the District's existing groundwater supply. Three phases of this study have been completed to date.

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The Phase 1 evaluation recommended a baseload delivery option for surface water delivery to the District (i.e., Table A supply will be evenly split and delivered for treatment over 12 months) and identified two preferred alternatives for conveyance of surface water supplies. The Phase 2 evaluation further refined the two preferred conveyance alternatives. The Phase 3 evaluation focused on evaluating updated water demands in the District and recent changes in groundwater conditions to determine if a stronger justification could be made to support the proposed surface water supply project. The Phase 3 evaluation results continued to support a surface water supply project for the District.

More specifically, in the January 2014 draft TM prepared by West Yost for the Chico District's Phase 3 Surface Water Supply Feasibility Study, West Yost recommended that the 2030 baseline scenario in the Butte County's Butte Basin groundwater model could be used with updated buildout water demands for the District to simulate and compare the relative changes in groundwater levels and assess how changes in groundwater use in the District, climate change (as it relates to the availability of surface water for irrigation), and expansion of permanent crops (drip irrigation) could potentially affect groundwater levels in the aquifer. To address this recommendation from the Phase 3 evaluation, Cal Water requested West Yost to proceed with using the BCIWFM to evaluate groundwater conditions for the District.

The following sections of this TM document the methodology used to update the District's water demands and monitoring locations in the BCIWFM and also summarize the results from the subsequent BCIWFM evaluations.

DEVELOPMENT OF WATER DEMAND SCENARIOS AND SENSITIVITY ANALYSIS

The following sections provide a brief overview of the BCIWFM and describe how West Yost developed the Chico District's urban water demand scenarios and sensitivity analysis by making updates to the 2030 baseline scenario version of the BCIWFM.

Overview of the BCIWFM

The County developed an Integrated Water Flow Model in 2008 by converting its Butte Basin Water Users Association groundwater model to the California Department of Water Resources' (DWR) Integrated Water Flow Model (IWFM) code. IWFM is a peer reviewed, publicly available, integrated water resources model supported by DWR. As part of the model conversion, model inputs were revised, the model was calibrated, and a baseline scenario was developed (CDM, 2008a). Figure 1 illustrates the boundary of the BCIWFM domain and individual subregions.

The baseline scenario in the BCIWFM incorporated updated land use, urban pumping, and surface water diversions projected to the year 2030. The 2030 baseline scenario uses the historical time series data from the calibration version of the model with some modification, resulting in a 29-year simulation based on the historical hydrology for water years 1971 through 1999 (CDM, 2008b). This historical hydrologic period includes a wide range of wet and dry years, including the 1976-1977 and 1987-1992 droughts. Surface water diversions are approximated based on water years 1995-1999. The diversions were then adjusted based on the hydrologic conditions for each year of the simulation using the water year index.

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Water Demand Scenarios

The BCIWFM represents historical urban demands, which are met by groundwater, as defined model input specified by groundwater pumping at specific well locations. Therefore, to simulate updated groundwater levels for this evaluation, West Yost updated the groundwater pumping specification input files in the BCIWFM to reflect the current 2013 and updated 2030 water demands for the District. The 2013 demands reflect current metered use, and the 2030 demands reflect full implementation of metering and planned conservation measures. An additional scenario to simulate conjunctive use was also developed as discussed below.

Current 2013 Water Demand Scenario

Cal Water provided West Yost with the monthly groundwater production by well in 2013 to update the 2013 pumping time series for the wells located in the District's service area. The 2013 monthly groundwater production data is provided in Attachment A for reference, and the District's well locations are shown on Figure 2.[1]

Updated 2030 Water Demand Scenario

Previously in the District's Phase 3 Surface Water Supply Feasibility Study, West Yost assessed the levels of demand incorporated in the BCIWFM for the purpose of determining whether, and to what extent, the 2030 water demands would need to be updated in the BCIWFM to be consistent with the current updated water demand projection estimated for the District. This assessment indicated that the urban groundwater pumping, or equivalently, demand, in the 2030 baseline scenario of the BCIWFM was simulated at 44,749 af/yr for the District's wells, which is considerably higher than Cal Water's current 2030 water demand projection of 33,589 af/yr (Cal Water, 2014). Because of the decrease in the projected 2030 water demand, the 2030 baseline scenario in the BCIWFM was updated to reflect the more recent and lower 2030 water demand projection.

West Yost used historical data from 2004 to help estimate the projected 2030 monthly groundwater production by municipal well. The 2004 monthly groundwater production data was used to project the 2030 pumping time series because the total groundwater production in 2004 (30,875 af/yr) was similar to the projected 2030 water demand of 33,589 af/yr. The remaining groundwater production required to support the 2030 water demand (2,714 af/yr) was allocated to either new groundwater wells that were assumed to be constructed or existing wells that were assumed to have been re-activated since 2004.

Conjunctive Use Scenario

A model scenario was developed to assess groundwater levels if the District implemented a conjunctive use program using water made available from the SWP through the County's Table A supply. Under the conjunctive use scenario, the available surface water supply would be used to meet future urban water demands in the Chico District service area. Groundwater would continue to be used whenever the available surface water supply was insufficient to meet demands. The scenario was based on the updated 2030 Chico District water demands described above.

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[1] Wells 67-01, 68-01, 69-01, 70-01, 71-01, 72-01, 75-01, 76-01, 79-01, 80-01, and the four State Wells were not included in the BCIWFM and were subsequently added into the BCIWFM based on data provided by Cal Water staff.

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Butte County Area of Origin Settlement

On December 31, 2013, the County entered into an Area of Origin Settlement Agreement (Settlement Agreement), which settled contested issues related to the area of origin statues in the California Water Code. The Settlement Agreement resulted in Amendment No. 21 to the Water Supply Contract between The State of California Department of Water Resources and Butte County (Amendment 21). The Settlement Agreement and Amendment 21 are provided in Attachment B.

The projected annual surface water deliveries used in the conjunctive use scenario was developed using the Settlement Agreement and Amendment 21. Table 1 provides the Butte County Allocations listed in the Settlement Agreement and Amendment 21. This table relates the State's South of Delta (SOD) allocation as a percentage of Table A supply to the County's allocation in acre-feet.

Table 1. Butte County Allocation Table[a]

	SOD Allocation, percent	Butte County Allocation, af
Conference Years[b] SOD = 0 to 20%	0	3,000
	5	3,000
	10	4,000
	15	5,000
	20	6,000
SOD = 21 to 100% Butte County Allocation = SOD + 30% until 60%, then 100% thereafter.	25	15,125
	30	16,500
	35	17,875
	40	19,250
	45	20,625
	50	22,000
	55	23,375
	60	27,500
	65	27,500
	70	27,500
	75	27,500
	80	27,500
	85	27,500
	90	27,500
	95	27,500
	100	27,500

[a] Source: Amendment No. 21 to Water Supply Contract between The State of California Department of Water Resources and Butte County in Settlement Agreement and Release Regarding Butte County, December 31, 2013.

[b] A conference year is a year in which the current SOD allocation is less than or equal to 20 percent.

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Projected Available Surface Water Supply for the Chico District

Per the approach described in the Settlement Agreement and Amendment 21, the County's Table A supply was allocated by first estimating DWR's future SOD percentage allocation using Table 8 from the 2013 Draft Technical Addendum to the State Water Project Reliability Report (DWR, 2013). Table 8 lists DWR's forecasts of the deliveries from the Delta for a 2033 level of demand for water years 1922 through 2003. The assessment was conducted for the water years used in the BCIWFM simulations (1971 through 1999). The County's supply in acre-feet was then determined for each year based on the Butte County Allocations listed in Table 1. These annual values were then reduced by 450 acre-feet to account for the County's current firm water demand. Figure 3 shows the projected annual Table A supply allocations to the Chico District for water years 1971 through 1999. The annual Table A supply allocations ranged from a minimum of 3,750 acre-feet in 1977 to a maximum of 27,050 acre-feet in 18 of 29 water years. The average Table A supply allocation was projected to be 21,613 acre-feet.

For this effort, it was assumed that the County's Table A supply allocation for each year was evenly distributed throughout the months of the year. The resulting monthly time series for water years 1971 through 1999 was input to the BCIWFM as a new point of diversion located outside of the model domain. All deliveries from this new point of diversion were used to meet the fixed 2030 level of demand simulated for the District. In months where the water demand in the District is lower than the quantity of Table A supply available, the Table A supply was reduced to match the monthly water demand. Groundwater pumping was assumed to meet any monthly deficits between the surface water deliveries and the projected water demand.

Sensitivity Analysis

In addition to the updated water demand scenarios, West Yost also conducted a sensitivity analysis using the BCIWFM to assess the sensitivity of groundwater levels to the following:

- Changes in the District's groundwater demands; and
- Increases in the use of groundwater for irrigated agriculture as a way to evaluate: (1) climate change and the reduced availability of surface water supplies, and (2) potential expansion of permanent crops and drip irrigation.

Four model runs were originally developed for the sensitivity analysis. The first two runs were developed to assess the effects of different levels of 2030 water demands in the District and the other two runs were used to assess the increase in the agricultural use of groundwater for the subregions in and surrounding the District. However, results from the last two runs indicated that the subregions in and surrounding the District were already primarily using groundwater to meet agricultural demands. Therefore, two additional model runs were added to assess groundwater levels if the agricultural use of groundwater was increased globally for all subregions in the BCIWFM.

Monitoring Locations

The output file of the BCIWFM was modified to specify hypothetical monitoring wells at five locations distributed across the District and four other locations in the agricultural areas surrounding the District. Figure 4 illustrates the locations of the hypothetical monitoring wells.

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Groundwater levels simulated at these hypothetical monitoring well locations were evaluated for both the updated water demand scenarios and the sensitivity analysis. The output groundwater levels for each hypothetical monitoring well were graphed to enable comparison of the groundwater levels under different scenarios.

GROUNDWATER MODEL RESULTS

Table 2 summarizes the scenarios evaluated using the BCIWFM. For each scenario, hydrographs were developed for the BCIWFM layer 6[2], which is representative of the depth intervals of the District's wells. Results for these scenarios are discussed below.

Results from Water Demand Scenarios

Figure 5 illustrates the simulated hydrographs at the nine hypothetical monitoring wells for the water demand scenarios (refer to yellow scenarios in Table 2) and compares them to the Base scenario. Individual hydrograph figures for each monitoring well location shown on Figure 5 are provided in Attachment D. Compared with the Base scenario, the updated BCIWFM results for the water demand scenarios indicate the following:

1. the lowest groundwater pumping condition in the District (2030 CW – CU scenario representing conjunctive use) corresponds to the highest groundwater levels in the surrounding aquifer (see red line in hydrograph figures), and
2. the highest groundwater pumping condition in the District (Base scenario representing previous higher water demand projections for the District) corresponds to the lowest groundwater levels in the surrounding aquifer (see blue line in hydrograph figures).

These results indicate that reduced groundwater pumping, especially with the introduction of treated surface water supply (i.e., conjunctive use) in the District, would improve the conditions in the surrounding groundwater aquifer. As shown on Figure 5, monitoring locations located within and east of the District service area appear to show more improvement in groundwater levels with conjunctive use than compared with monitoring locations in the west of the District service area (i.e., larger differences between the red and blue lines). This indicates that impacts from conjunctive use are more pronounced within the localized region of the Chico District.

Table 3 presents the annual agricultural areas and Chico District water budgets for each scenario that was evaluated using the BCIWFM. The water budgets for the agricultural areas stayed the same for the water demand scenarios (2013 CW, 2030 CW, and 2030 CW – CU) as the model inputs for the agricultural areas were not adjusted; however, the water budgets for the District varied either primarily due to adjustments in water demand (2013 CW and 2030 CW) or from the introduction of treated surface water supply (2030 CW – CU). In the 2030 CW – CU conjunctive use scenario, annual groundwater pumping was reduced to approximately 10,500 acre-feet when treated surface water supply was used to meet the District's projected 2030 water demands. This indicates that when treated surface water use is at 23,100 af/yr, groundwater pumping only accounts for approximately 30 percent of the District's annual water supply.[3]

[2] Tuscan Formation, Unit B (CDM, 2008a).

[3] This percentage can be further reduced by another 10 percent if the annual surface water diversion was increased to match the maximum projected annual Table A supply that could be available (27,050 af). Because it was assumed that the

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Table 2. Summary of BCIWFM Scenarios Evaluated[a]		
Scenario Name	Purpose	Description
Base	Provides a relative baseline for comparison with other scenarios.	• No changes from County 2030 baseline scenario • Base conditions with groundwater pumping in the District set at 44,749 af/yr
2013 CW	Provides an assessment of measured 2013 District groundwater pumping.	• Adjust groundwater pumping in the District to match 2013 groundwater production data (26,915 af/yr)
2030 CW[b]	Provides an assessment of projected 2030 District groundwater pumping.	• Adjust groundwater pumping in the District to match updated 2030 AVG w/ Cons water demand projection (33,589 af/yr)
2030 CW – CU	Provides an assessment of projected 2030 District demands met using treated surface water supplemented by groundwater pumping.	• Start with 2030CW scenario • Simulate proposed conjunctive use • Table A supply deliveries based on future SWP reliability conditions (DWR, 2013) and the County's Area of Origin settlement agreement
2030 CW – S1[b]	Provides an assessment of the model's sensitivity to changes in projected 2030 District groundwater pumping.	• Adjust groundwater pumping in the District to match updated 2030 AVG water demand projection (39,292 af/yr)
2030 CW – S2[b]		• Adjust groundwater pumping in the District to match updated 2030 AVG + SD water demand projection (45,022 af/yr)
2030 CW – S3	Provides an assessment of the model's sensitivity to reductions in surface water availability in the agricultural areas surrounding the District's service area.	• Start with 2030CW scenario • Reduce local surface water diversions by 10% (Subregions 2, 3, 4, and 5)
2030 CW – S4		• Start with 2030CW scenario • Reduce local surface water diversions by 20% (Subregions 2, 3, 4, and 5)
2030 CW – S5	Provides an assessment of the model's sensitivity to reductions in surface water availability in agricultural areas throughout the model domain.	• Start with 2030CW scenario • Reduce surface water diversions by 5% globally
2030 CW – S6		• Start with 2030CW scenario • Reduce surface water diversions by 20% globally

[a] Yellow scenarios assess groundwater level changes due to adjustments in Chico District groundwater production, including adjustments to pumping brought about by implementation of a conjunctive use project with a treated surface water component. Green scenarios assess the sensitivity of simulated groundwater level changes to varying levels of projected 2030 District demand and varying reductions in surface water deliveries to agricultural areas.
[b] See Attachment C for updated 2030 water demand projections.

County's Table A supply allocation for each year was evenly distributed throughout the months of the year, the Table A supply was reduced to match the monthly water demand in months where the water demand in the District is lower than the quantity of Table A supply available.

Table 3. Butte County IWFM Agricultural and Urban Annual Water Budgets

Scenario Name[a]		Agricultural Areas, af			Chico District, af		
		Agricultural Supply Requirement	Groundwater Pumping	Surface Water Diversion	Water Demand	Groundwater Pumping	Surface Water Diversion
Base	Average	1,494,444	543,478	1,157,220	44,749	44,749	-
	Minimum	1,314,919	418,944	1,052,198			
	Maximum	1,634,358	616,681	1,244,970			
2013 CW	Average	1,494,444	543,473	1,157,267	26,915	26,915	-
	Minimum	1,314,919	418,943	1,052,221			
	Maximum	1,634,359	616,650	1,245,009			
2030 CW	Average	1,494,444	543,481	1,157,252	33,589	33,589	-
	Minimum	1,314,919	418,943	1,052,186			
	Maximum	1,634,359	616,645	1,244,990			
2030 CW - CU: Proposed Conjunctive Use in Chico District[b]	Average	1,494,444	543,489	1,157,303	33,589	14,650	18,939
	Minimum	1,314,919	418,938	1,052,356		10,488	3,751
	Maximum	1,634,358	616,648	1,244,998		29,839	23,101
2030 CW - S1: Increase Chico District Demands to AVG	Average	1,494,444	543,489	1,157,238	39,262	39,262	-
	Minimum	1,314,919	418,944	1,052,156			
	Maximum	1,634,358	616,671	1,244,980			
2030 CW - S2: Increase Chico District Demands to AVG+SD	Average	1,494,444	543,471	1,157,231	45,022	45,022	-
	Minimum	1,314,919	418,947	1,052,141			
	Maximum	1,634,358	616,695	1,244,978			
2030 CW - S3: Decrease Local Surface Water Diversions by 10%	Average	1,494,451	544,908	1,155,746	33,589	33,589	-
	Minimum	1,314,937	420,268	1,050,842			
	Maximum	1,634,360	617,687	1,243,051			
2030 CW - S4: Decrease Local Surface Water Diversions by 20%	Average	1,494,458	546,320	1,154,228	33,589	33,589	-
	Minimum	1,314,955	421,621	1,049,431			
	Maximum	1,634,361	618,802	1,241,111			
2030 CW - S5: Decrease Global Surface Water Diversions by 5%	Average	1,496,276	556,409	1,100,852	33,589	33,589	-
	Minimum	1,314,951	426,935	1,000,030			
	Maximum	1,639,499	633,305	1,184,612			
2030 CW - S6: Decrease Global Surface Water Diversions by 20%	Average	1,512,949	616,303	931,657	33,589	33,589	-
	Minimum	1,315,070	476,788	843,996			
	Maximum	1,721,007	700,533	1,003,672			

(a) Annual values are listed for all scenarios.

(b) Projected annual Table A supply was assumed to be evenly split and delivered for treatment over 12 months. In months where the water demand is lower than the quantity of Table A supply available, the Table A supply was reduced to match the monthly water demand. Therefore, the maximum annual surface water diversion (23,101 af) is lower than the maximum projected annual Table A supply that would be available (27,050 af).

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Results from Sensitivity Analysis

Figure 6 illustrates the simulated hydrographs at the nine hypothetical monitoring wells for the sensitivity analysis (refer to green scenarios in Table 2) and compares them to the 2030 CW scenario. The results from the 2030 CW – CU conjunctive use scenario (see red line in hydrograph figures) were also plotted to provide a comparison to see how groundwater levels would differ with the introduction of treated surface water to the District. Individual hydrograph figures for each monitoring well location are provided in Attachment E. Compared with the 2030 CW scenario, the updated BCIWFM results for the sensitivity analysis indicate the following:

1. reductions in surface water diversions in the agricultural areas (2030 CW – S3, 2030 CW – S4, 2030 CW – S5, and 2030 CW – S6 scenarios) negatively impact the groundwater levels, but these impacts are relatively minor within the District service area (i.e., there are only small differences between hydrographs for these scenarios);
2. groundwater levels within and east of the District service area are affected more by additional groundwater pumping (2030 CW – S2 scenario represents an increase of 2030 District water demands by 35 percent, see orange line in hydrograph figures); and
3. the 2030 CW – CU scenario representing conjunctive use continues to correspond with the highest groundwater levels in the aquifer surrounding the District (see red line in hydrograph figures).

These results from the sensitivity analysis continue to indicate that reduced groundwater pumping especially with the introduction of treated surface water supply (i.e., conjunctive use) to the District would improve the conditions in the surrounding groundwater aquifer and could potentially reverse some of the groundwater level impacts due to increases in the use of groundwater for irrigated agriculture from climate change and/or expansion of permanent crops and drip irrigation.

The annual agricultural areas water budgets previously shown in Table 3 summarizes how the BCIWFM adjusted the groundwater pumping to meet the reductions in surface water diversions for the 2030 CW – S3, 2030 CW – S4, 2030 CW – S5, and 2030 CW – S6 scenarios in the sensitivity analysis.

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SUMMARY OF KEY FINDINGS AND CONCLUSIONS

In summary, results from this evaluation performed using the BCIWFM indicate that the District's groundwater use is a relatively small component of the surrounding regional groundwater use. Therefore, changes in groundwater use within the District do not significantly impact the groundwater levels outside of the localized region of the District. However, results from the BCIWFM indicate that reduced groundwater use within the District service area, especially with the introduction of treated surface water supply (conjunctive use) has the ability to improve groundwater levels by approximately 10-15 feet within the localized region of the District. Therefore, results from this BCIWFM evaluation continue to support the District's Surface Water Supply Feasibility Study project because the project will provide the following benefits:

- Improve groundwater levels for District wells through in-lieu banking of local groundwater;
- Address projected uncertainties in future water supply availability due to reduced groundwater supply (from increased water use from other users and/or deteriorating aquifer conditions), climate change (extended drought conditions), and other factors;
- Reduce dependence on the groundwater supply and provide additional reliability and flexibility in the District's future water supply portfolio; and
- Improve environmental, operational and water quality conditions for multiple parties.

In addition, more recent groundwater legislation may force action to ensure sustainability of the groundwater aquifer and would make the District's proposed surface water supply project more desirable from a regional perspective. West Yost recommends that Cal Water evaluate the potential for a regional surface water supply project to garner support and/or funding. Possible partners could include Butte County, Paradise Irrigation District and the Durham Irrigation District.

Based on the findings and conclusions from this work effort, the following tasks are recommended to continue the development of the project and can be completed as additional phases of the Surface Water Supply Feasibility Study.

- Identify strategic partners and funding opportunities
- Evaluate the potential for a regional surface water supply project
- Perform site-specific studies at the proposed point of diversion for the radial collector wells
- Layout conceptual transmission facilities for preferred conveyance alternatives
- Conduct water treatment plant evaluation
- Analyze/Select a Preferred Alternative

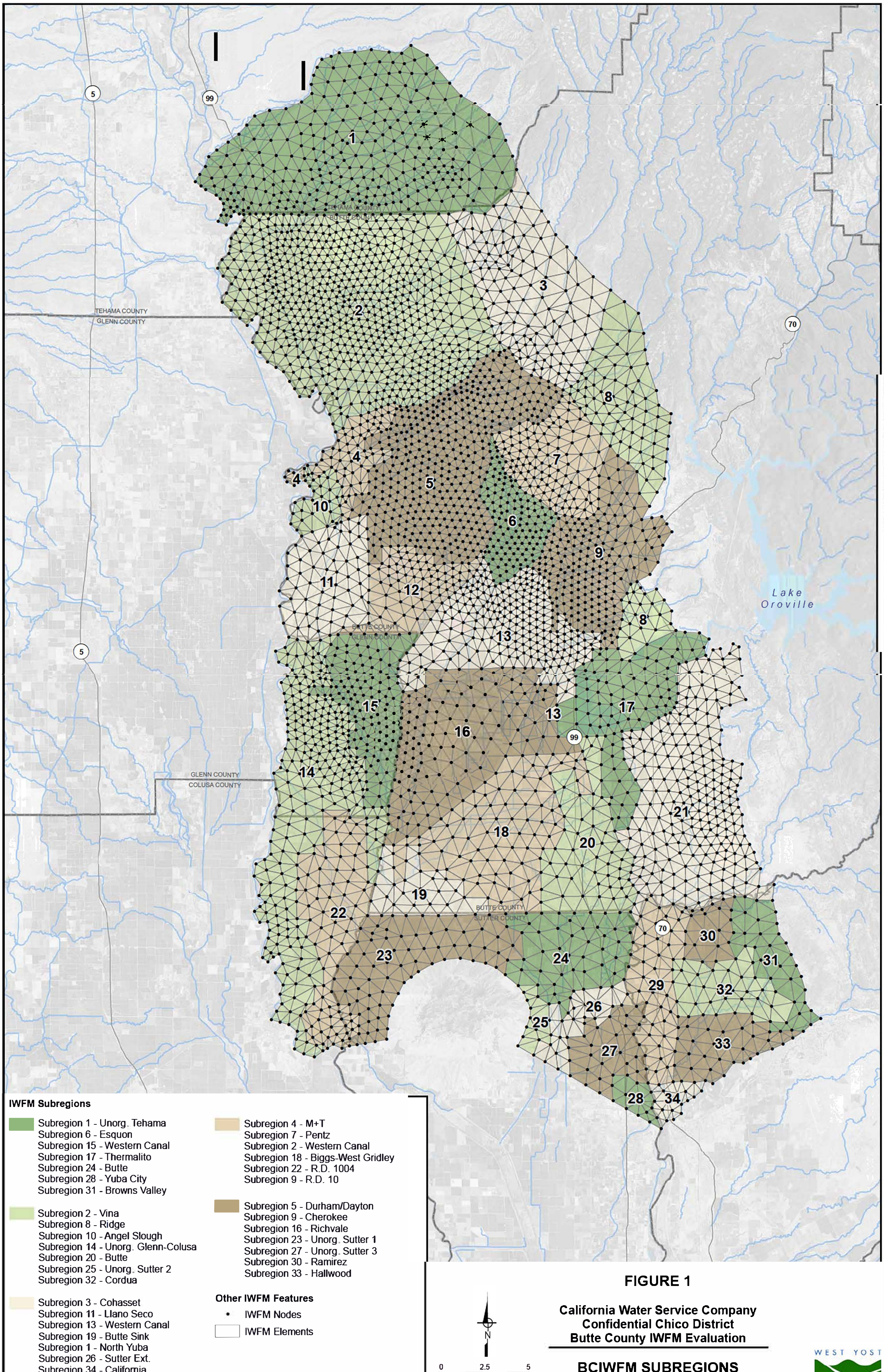

FIGURE 1

California Water Service Company
Confidential Chico District
Butte County IWFM Evaluation

BCIWFM SUBREGIONS

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[redacted]

Redacted pursuant PDD / NSC - 63; location information.

Chico District Service Area
Active Well
Standby Well
Inactive Well

N

0 2,000 4,000
Scale in Feet

FIGURE 2

California Water Service Company
Confidential Chico District
Butte County IWFM Evaluation

CHICO DISTRICT WELL LOCATIONS

WEST YOST ASSOCIATES

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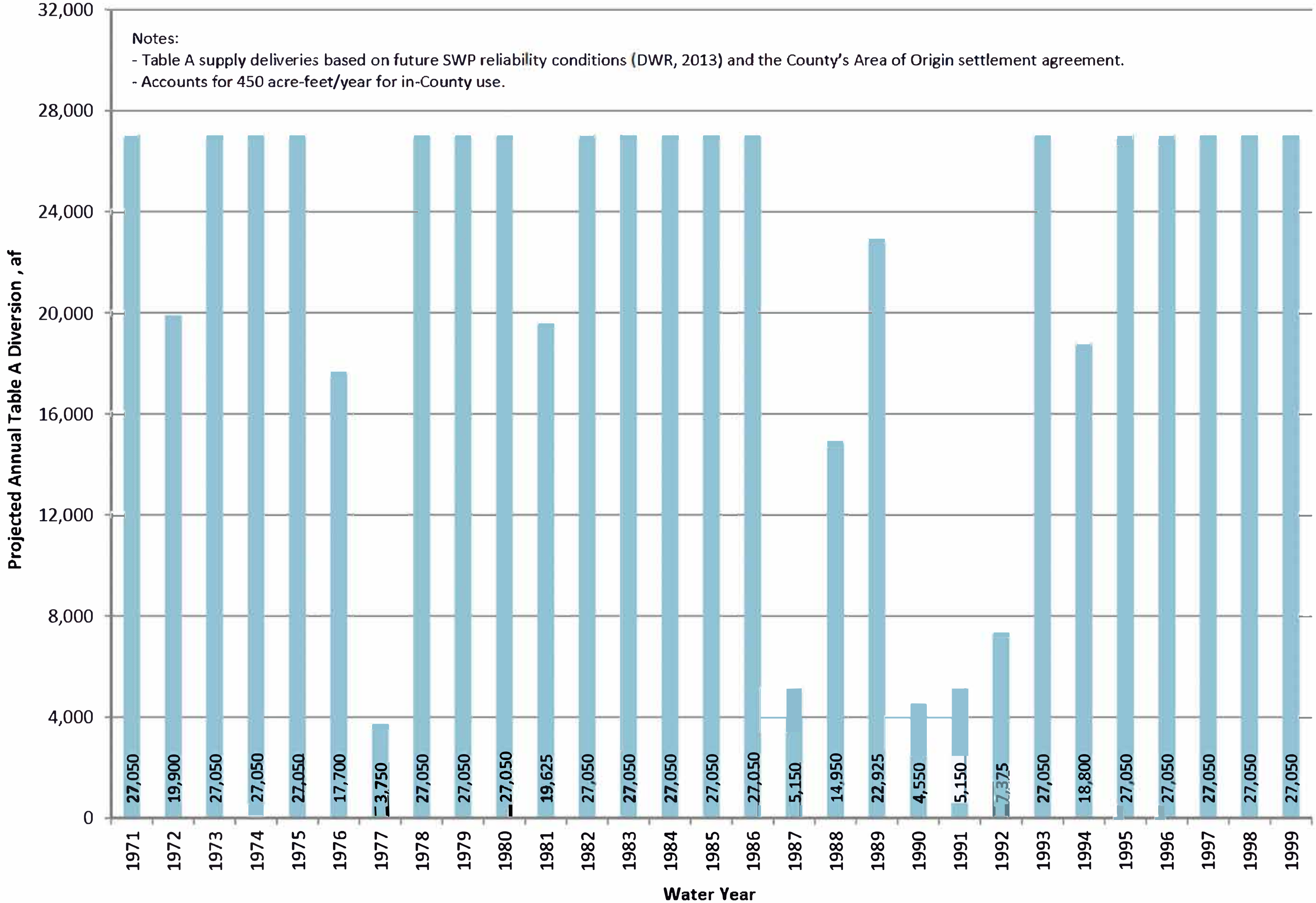
Figure 3. Projected Annual Table A Supply Delivery to the Chico District



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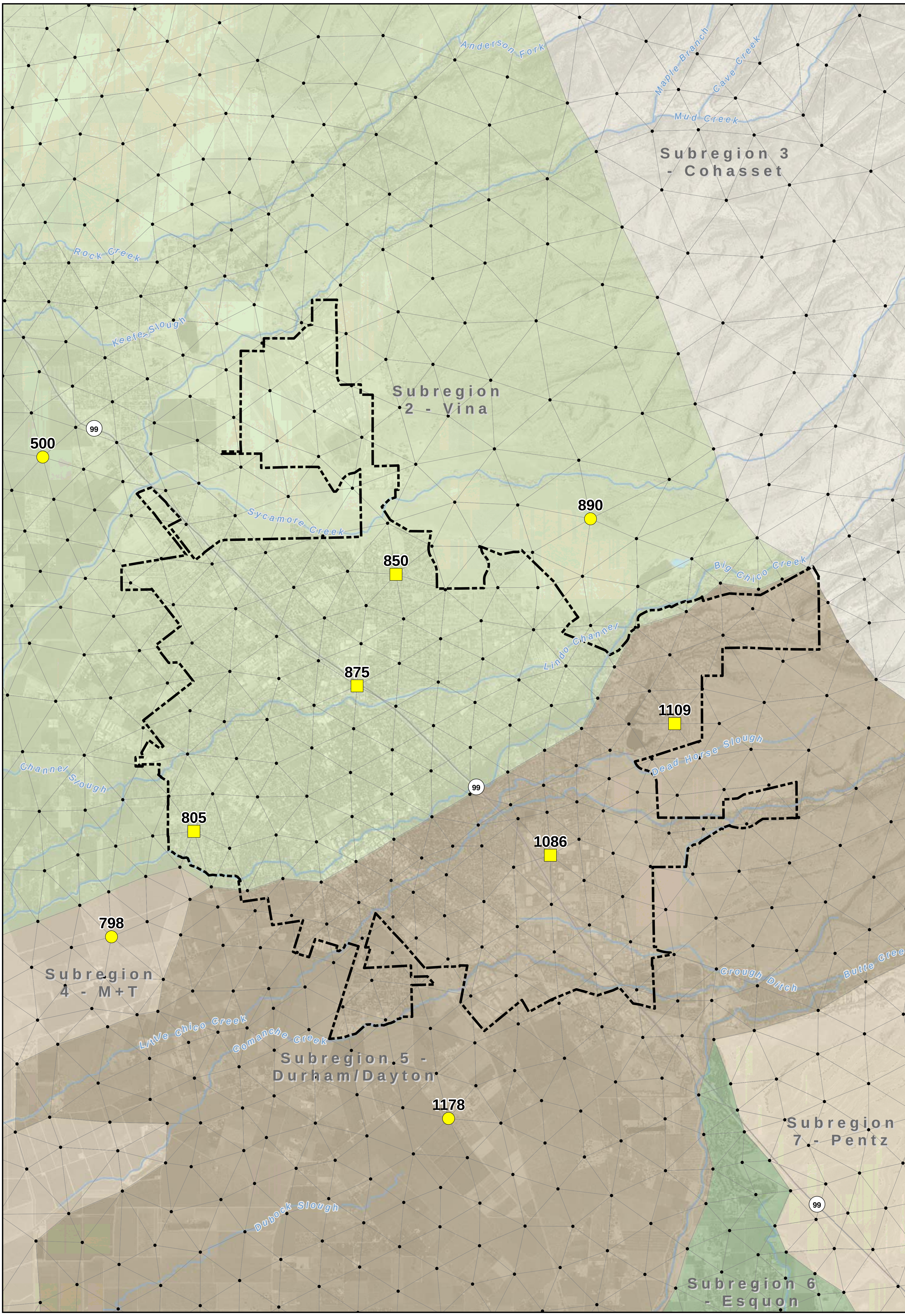

IWFM Subregions

- Subregion 2 - Vina
- Subregion 3 - Cohasset
- Subregion 4 - M+T
- Subregion 5 - Durham/Dayton
- Subregion 6 - Esquon
- Subregion 7 - Pentz

Proposed Location for Model Hydrograph

- Location Within District
- Location Within Agricultural Areas Outside of District
- Chico District Service Area

Other IWFM Features

- IWFM Nodes
- IWFM Elements

N

0 2,500 5,000

Scale in Feet

FIGURE 4

California Water Service Company
Confidential Chico District
Butte County IWFM Evaluation

MONITORING LOCATIONS

WEST YOST ASSOCIATES

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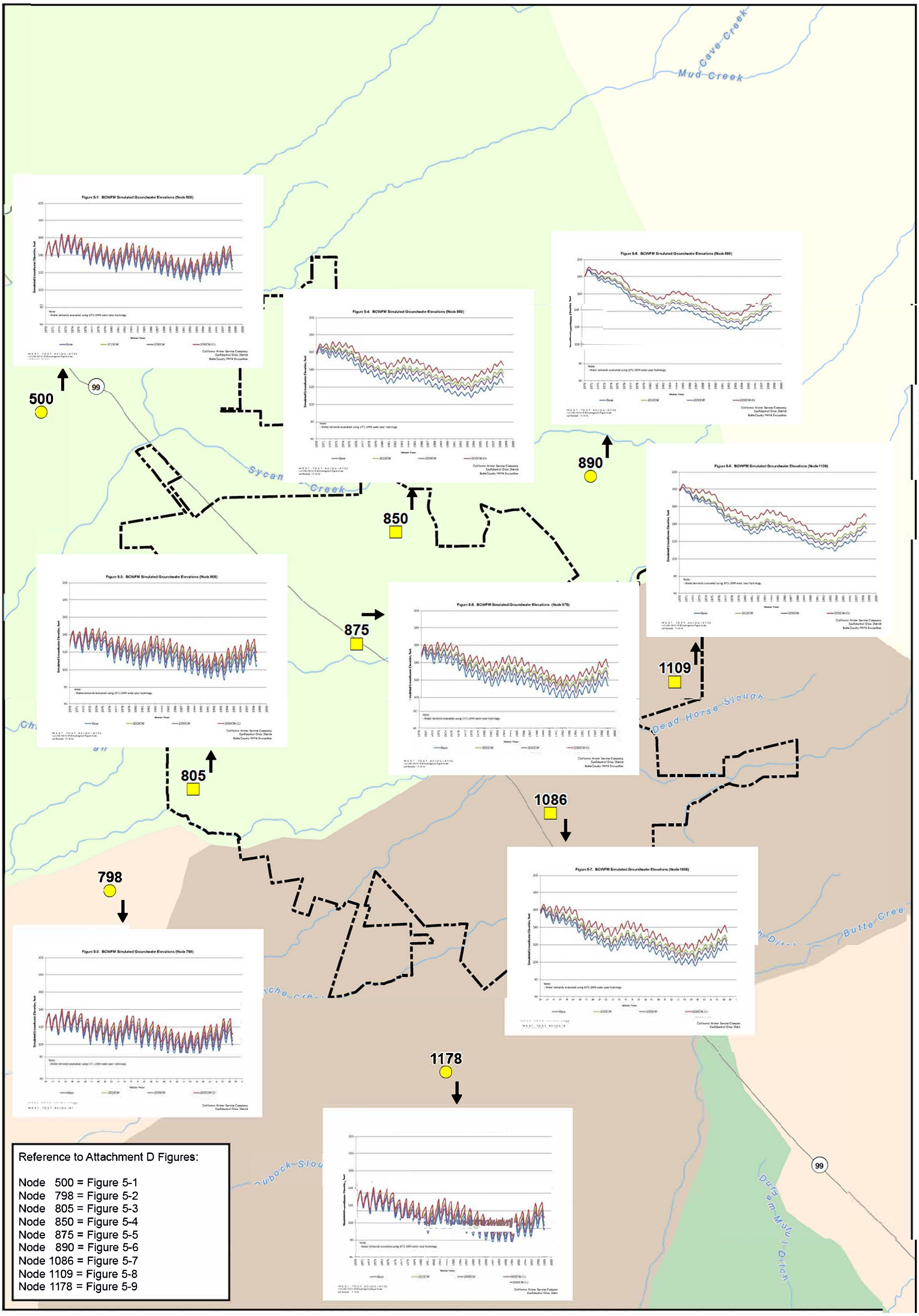

IWFM Subregions

- Subregion 2 - Vina
- Subregion 3 - Cohasset
- Subregion 4 - M+T
- Subregion 5 - Durham/Dayton
- Subregion 6 - Esquon
- Subregion 7 - Pentz

Location for Model Hydrograph

- Location Within District
- Location Within Agricultural Areas Outside of District
- Chico District Service Area

0 2,500 5,000

Scale in Feet

N

FIGURE 5

California Water Service Company
Confidential Chico District
Butte County IWFM Evaluation

RESULTS FROM DEMAND SCENARIOS

WEST YOST ASSOCIATES

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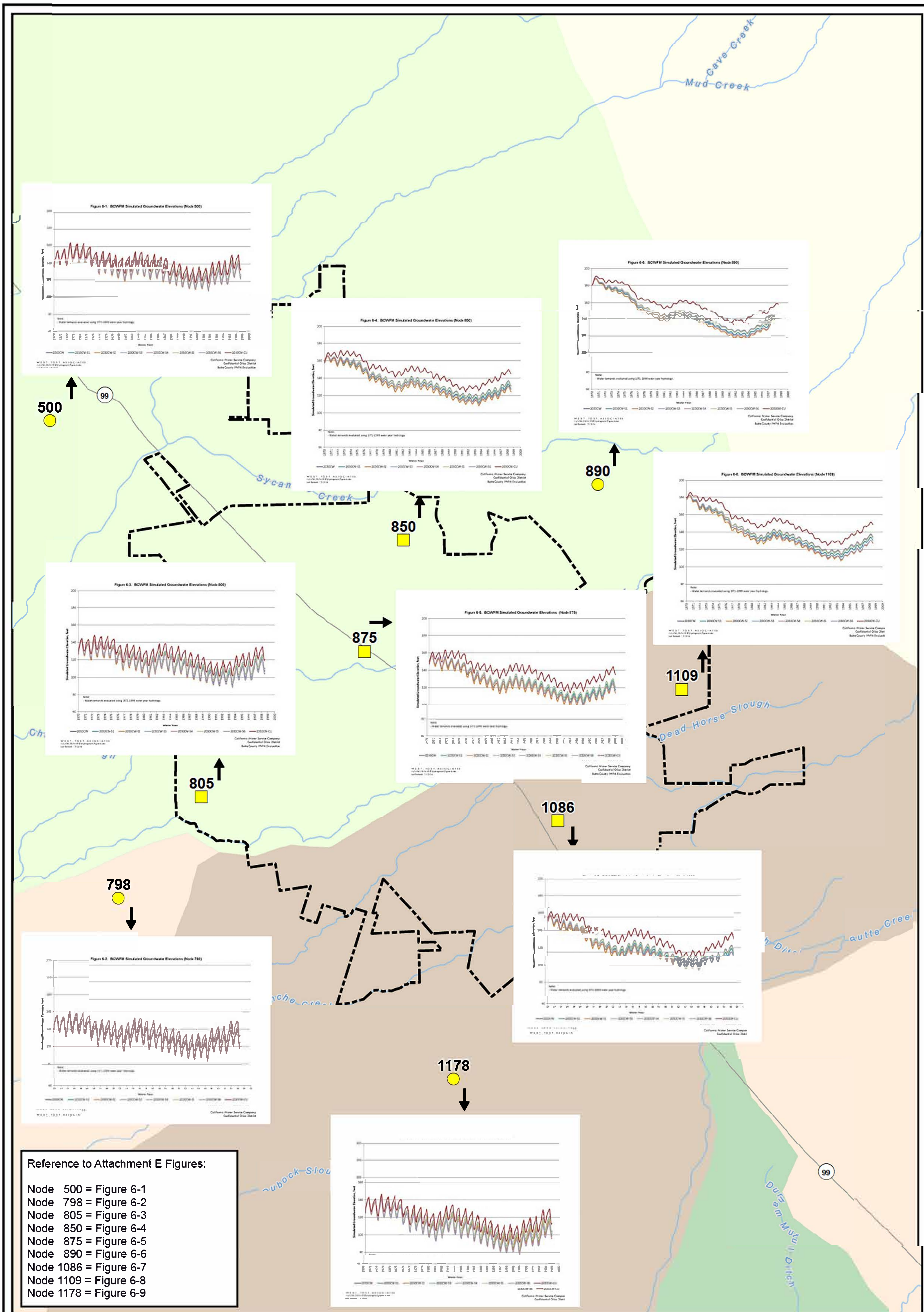

IWFM Subregions

- Subregion 2 - Vina
- Subregion 3 - Cohasset
- Subregion 4 - M+T
- Subregion 5 - Durham/Dayton
- Subregion 6 - Esquon
- Subregion 7 - Pentz

Location for Model Hydrograph

- Location Within District
- Location Within Agricultural Areas Outside of District
- Chico District Service Area

N

0 2,500 5,000

Scale in Feet

FIGURE 6

California Water Service Company
Confidential Chico District
Butte County IWFM Evaluation

RESULTS FROM SENSITIVITY ANALYSIS

WEST YOST ASSOCIATES

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ATTACHMENT A

Chico District – 2013 Monthly Groundwater Production

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CWS WELL #/ STATUS	LOCATION	MONTHLY PRODUTION IN KGALS JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	**TOTAL**
CH-001-04 INACTIVE	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	**0**
CH-003-03 INACTIVE	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	**0**
CH-004-02 INACTIVE	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	**0**
CH-005-02 ACTIVE	[redacted]	231	121	0	261	1,527	14,724	153	92	31	620	1,871	19	**19,650**
CH-007-04 ACTIVE	[redacted]	275	185	0	1,120	625	172	5,032	6,336	7,355	82	98	0	**21,280**
CH-008-01 ACTIVE	[redacted]	69	750	166	194	117	4,510	6,778	7,282	6,717	6,793	519	109	**34,004**
CH-009-03 INACTIVE	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	**0**
CH-011-01 ACTIVE	[redacted]	69	93		147	3,181	218	0	356	0	0	139	0	**4,203**
CH-012-01 ACTIVE	[redacted]	798	7,825	3,104	6,549	6,740	7,604	10,988	15,176	11,690	16,152	6,007	165	**92,798**
CH-013-01 INACTIVE	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	**0**
CH-014-01 ACTIVE	[redacted]	0	0		10,391	22,534	21,093	21,592	21,433	13,752	0	0	0	**110,795**
CH-015-01 INACTIVE	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	**0**
CH-016-01 INACTIVE	[redacted]	35,774	10,865	37,200	19,602	32,989	30,503	30,125	0	0		0	0	**197,058**
CH-017-01 ACTIVE	[redacted]	85	7,549	16,634	18,684	17,698	22,396	26,667	26,599	15,621	97	83	258	**152,371**
CH-018-01 ACTIVE	[redacted]	0	0	167	0	39	14,872		750	414	0	257	77	**16,576**
CH-019-01 ACTIVE	[redacted]	0	212	167	3,013	9,522	13,277	21,528	14,385	6,172	0	161	0	**68,437**
CH-020-01 ACTIVE	[redacted]	0	0	0	0	9,685	26,415	27,205	26,867	25,873	7,782	0	0	**123,827**
CH-021-01 ACTIVE	[redacted]	27,934	6,505	0	0	81	0	0	0	0	14,699	24,132	25,026	**98,377**
CH-022-01 ACTIVE	[redacted]	14	84	0	700	5,115	9,140	10,780	8,837	7,303	436	1,377	0	**43,786**
CH-023-01 ACTIVE	[redacted]	202	0	142	100	137	292	13,028	5,554	0	189	7	0	**19,651**
CH-024-01 ACTIVE	[redacted]	24,937	23,575	25,840	9,118	24,616	18,093	16,571	23,795	23,468	24,429	23,787	25,144	**263,373**
CH-025-01 ACTIVE	[redacted]	0	0	128	713	8,957	8,646	9,887	8,929	6,984	6,295	565	0	**51,104**
CH-026-01 ACTIVE	[redacted]	26,243	26,446	28,104	27,338	27,976	27,253	28,065	28,077	27,036	27,724	27,132	28,743	**330,137**
CH-027-01 ACTIVE	[redacted]	0	100	113	2,061	3,161	10,069	12,086	9,008	6,281	4,657	230	0	**47,766**
CH-028-01 ACTIVE	[redacted]	0	2,632	25,217	24,302	24,052	9,255	0	0	0	0	0	0	**85,458**
CH-029-01 ACTIVE	[redacted]	171	0	0	404	11	553	2,030	5,393	1,778	409	0	0	**10,749**
CH-030-01 ACTIVE	[redacted]	0	118	2,888	7,491	11,935	16,661	21,867	17,644	13,807	13,256	5,522	126	**111,315**
CH-031-01 ACTIVE	[redacted]	0	0	0	30,069	31,044	30,058	30,507	30,004	28,538	8,697	0	0	**188,917**
CH-032-01 ACTIVE	[redacted]	5,073	402	309	4,075	28,637	2,840	18,479	19,494	16,054	22,495	14,016	1,631	**133,505**
CH-033-01 ACTIVE	[redacted]	0	0	0	17,694	23,441	22,627	23,090	23,028	21,247	2,314	0	0	**133,441**
CH-034-01 ACTIVE	[redacted]	126	106	101	624	2,184	6,858	7,575	10,552	7,943	7,335	414	220	**44,038**
CH-035-01 ACTIVE	[redacted]	22,265	30,327	36,195	28,536	34,837	32,578	33,501	34,585	33,289	34,358	34,438	35,979	**390,888**
CH-037-01 ACTIVE	[redacted]	0	1,827	22,054	14,591	16,412	30,369	35,889	30,104	14,882	10,874	3,432	24	**180,458**
CH-038-01 ACTIVE	[redacted]	46	3,568	638	16,661	17,970	22,504	33,149	35,112	27,251	32,926	16,833	1,124	**207,782**
CH-039-01 ACTIVE	[redacted]	0	0	13,861	16,523	18,416	14,495	30,593	20,413	8,921	29,541	22,647	15,538	**190,948**
CH-040-01 ACTIVE	[redacted]	7,823	0	0	0	0	0	0	9,242	27,594	28,765	28,489	28,940	**130,853**
CH-041-01 ACTIVE	[redacted]	0	309	131	0	1	1,094	0	1,177	199	0	0	129	**3,040**
CH-042-01 ACTIVE	[redacted]	110	0	1,052	6,989	19,321	19,988	14,453	16,593	15,730	10,807	3,793	264	**109,100**
CH-044-01 ACTIVE	[redacted]	1,710	1,960	2,650	840	3,610	8,700	5,040	9,100	9,270	4,990	4,080	3,990	**55,940**
CH-046-01 ACTIVE	[redacted]	2,176	19,603	20,788	17,646	18,023	10,621	14,500	22,490	21,591	22,650	16,936	22,101	**209,125**
CH-047-01 STANDBY	[redacted]	40	37	132	0	1,754	1,202	0	0	0	0	0	0	**3,165**
CH-048-01 ACTIVE	[redacted]	219	0	335	248	6,207	8,422	9,969	10,160	6,926	986	324	63	**43,859**
CH-049-01 ACTIVE	[redacted]	29,447	29,266	33,531	29,530	0	3,563	35,396	34,935	33,666	32,492	33,520	34,801	**330,147**
CH-050-01 ACTIVE	[redacted]	24,257	28,635	30,047	20,568	12,601	17,230	21,528	20,354	21,889	39,550	36,093	38,041	**310,793**
CH-051-01 ACTIVE	[redacted]	0	0	0	24,389	34,975	32,057	34,101	34,000	32,781	10,160	0	0	**202,463**
CH-052-01 INACTIVE	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	**0**
CH-053-01 ACTIVE	[redacted]	43,643	39,896	42,978	41,581	42,505	40,191	42,221	42,687	40,329	42,592	41,451	43,282	**503,356**
CH-054-01 ACTIVE	[redacted]	128	0	18,780	29,418	41,625	37,183	40,917	40,833	28,385	5,786	4,884	594	**248,533**
CH-055-01 INACTIVE	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	**0**
CH-056-01 ACTIVE	[redacted]	79	188	174	104	2,407	3,669	5,617	5,106	2,460	161	248	580	**20,793**
CH-057-01 ACTIVE	[redacted]	205	431	0	0	25,323	8,902	0	19,734	1,679	108	240	34	**56,656**
CH-058-01 INACTIVE	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	**0**
CH-059-01 ACTIVE	[redacted]	2,677	369		18,281	25,890	26,368	35,822	31,598	17,518	2,426	123	0	**161,072**
CH-061-01 ACTIVE	[redacted]	15,369	19,901	8,159	4,122	5,055	21,002	32,361	12,405	29,302	17,580	8,943	25,185	**199,384**
CH-062-01 ACTIVE	[redacted]	0	0	585	3,942	10,892	11,282	11,430	12,946	9,925	8,446	953	122	**70,523**
CH-063-01 ACTIVE	[redacted]	0	99	0	0	753	3,827	4,825	3,460	1,665	0	0	294	**14,923**
CH-064-01 ACTIVE	[redacted]	1,567	1,422	2,893	6,049	7,248	3,431	8,134	4,972	2,686	5,298	2,687	827	**47,214**
CH-065-01 ACTIVE	[redacted]	3,056	11,217	6,728	0	31,945	42,415	46,947	46,264	36,419	32,322	19,003	0	**276,316**
CH-067-01 ACTIVE	[redacted]	54	0	19,257	15,916	25,842	31,717	40,178	37,317	25,359	16,471	10,641	14,257	**237,009**
CH-068-01 INACTIVE	[redacted]	0	0	0	0	0	0	0	0	0	0	0	0	**0**
CH-069-01 ACTIVE	[redacted]	284	0	2,075	5,299	7,069	10,073	10,755	6,510	3,745	7,162	927	23	**53,922**
CH-070-01 ACTIVE	[redacted]	46,128	42,167	45,056	44,481	45,528	43,014	45,667	45,290	44,031	45,271	43,511	43,713	**533,857**
CH-071-01 ACTIVE	[redacted]	805	184	668	0	7,911	14,022	18,937	22,500	11,204	6,959	1,045	1,886	**86,121**
CH-072-01 ACTIVE	[redacted]	2,039	13,352	19,965	39,774	50,179	48,682	49,720	49,380	46,137	48,615	45,569	31,582	**444,994**
CH-075-01 ACTIVE	[redacted]	0	1,564	2,780	9,631	6,440	293	12,958	25,434	20,638	5,102	412	0	**85,252**
CH-076-01 ACTIVE	[redacted]	7,446	1,872	456	21,870	18,235	12,620	19,665	20,011	12,318	9,691	1,927	0	**126,111**
CH-079-01 ACTIVE	[redacted]	16,557	17,921	46,126	57,007	58,200	55,003	57,541	57,871	54,900	58,137	52,668	0	**531,931**
CH-080-01 ACTIVE	[redacted]	0	0	0	0	31,282	33,878	36,439	23,318	18,038	26,120	12,477	638	**182,190**
	[redacted]													**0**
CH-S 1,2,3,4 ACTIVE	[redacted]	18,947	17,421	11,570	18,161	18,852	16,799	17,212	72	0	0	0	0	**119,034**
	[redacted]													**0**
														0
														0
TOTALS FOR ALL SOURCES		**369,078**	**371,104**	**529,944**	**676,807**	**943,312**	**985,323**	**1,149,498**	**1,095,564**	**908,791**	**760,807**	**554,611**	**425,529**	**8,770,368**

Redacted pursuant PDD / NSC - 63; location information.

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ATTACHMENT B

Settlement Agreement and Release Regarding Butte County

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SETTLEMENT AGREEMENT AND RELEASE REGARDING BUTTE COUNTY

THIS SETTLEMENT AGREEMENT AND RELEASE ("Agreement") is entered into by and between BUTTE COUNTY ("PLAINTIFF" or "BUTTE COUNTY"); the California Department of Water Resources ("DWR"); and Alameda County Flood Control and Water Conservation District, Zone 7, Alameda County Water District, Antelope Valley-East Kern Water Agency, Castaic Lake Water Agency, Central Coast Water Authority, Coachella Valley Water District, Kern County Water Agency, Metropolitan Water District of Southern California, Mojave Water Agency, Palmdale Water District, San Gorgonio Pass Water Agency, Santa Clara Valley Water District, and Tulare Basin Water Storage District (the "INTERVENORS") as of the last date executed below, referred to herein collectively as the "Parties" and each individually as a "Party."

RECITALS

A. WHEREAS, on or about July 17, 2008, Plaintiff filed a civil action against DWR in the Superior Court of California for the County of Sacramento (the "Court") Case No. 34-2008-00016338 CU-BC-GDS), and on or about March 2, 2009 the Court granted Intervenors' Motion to Intervene in the action (the complaint and the complaint in intervention are collectively referred to as the "Action");

B. WHEREAS, Plaintiff and each of the Intervenors has a contract with DWR for a supply of water from the State Water Project ("SWP") which existing contracts are referred to as the "SWP Contracts" or "Water Supply Contracts";

C. WHEREAS, the Parties' claims in the Action relate to disputes over the meaning of the Water Supply Contracts regarding Plaintiffs' claimed rights to water under their Contracts pursuant to Water Code section 11460, *et seq.*, and section 10505, commonly referred to as the "area of origin statutes";

D. WHEREAS, each Party disputes the interpretation of the SWP Contracts advanced by the other Parties, and DWR and Intervenors dispute whether any of the Plaintiffs have established area of origin rights and each Party denies that any other Party is entitled to any relief based on the claims alleged in the Action;

E. WHEREAS, the Parties wish to compromise, resolve, settle, and terminate any and all of the disputes or claims in the Action on terms and conditions set forth herein (the "Settled Disputes and Claims"). The Settled Disputes and Claims include any and all disputes or claims related to whether any Plaintiff is entitled to a preference in water deliveries from the SWP under the terms of the existing SWP Contracts;

F. WHEREAS, the Parties represent that they understand they are waiving significant legal rights by signing this Agreement, and each Party in no way admits responsibility for debts, liability, and/or obligations owed to any other Party or third parties, and this Agreement is made in a spirit of compromise for the sole purpose of

avoiding the uncertainties and expenses of litigation with respect to the Settled Disputes and Claims.

G. NOW, THEREFORE, in consideration of the mutual covenants contained herein, and intending to be legally bound hereby, the Parties agree as follows:

AGREEMENT

1. Recitals Incorporated. The recitals set forth above, including all definitions therein, are expressly incorporated as terms of this Agreement.

2. Terms of Settlement.

 2.1 Contract Amendment. Subject to the Conditions Precedent set forth in Section 3 of this Agreement, Plaintiff[1] and DWR[2] shall enter into an amendment to Plaintiff's SWP Contract, attached hereto as **Exhibit A**, that incorporates all of the provisions of this Settlement Agreement.

 2.2 Butte County Allocation: For purposes of determining available water for Plaintiff under the Water Supply Contract, DWR shall first determine the South of Delta ("SOD") allocation and then allocate Butte County's Table A for use in its service area[3] in accordance with the following Butte County Allocation Table ("BC Table"):

Butte County ("BC") Allocation Table

	SOD ALLOCATION (%)	BUTTE COUNTY ALLOCATION (AF)
Conference Years SOD = 0 to 20%	0	3,000
	5	3,000
	10	4,000
	15	5,000
	20	6,000
SOD = 21 to 100% Butte County Allocation = SOD + 30% until 60%, then 100% thereafter	25	15,125
	30	16,500
	35	17,875
	40	19,250
	45	20,625
	50	22,000
	55	23,375

[1] The term "Plaintiff" or "Butte County" in this Settlement Agreement is synonymous with the term "Agency" in the Butte County Water Supply Contract.
[2] The term "DWR" in this Settlement Agreement is synonymous with the term the 'State" in the Butte County Water Supply Contract.
[3] Service area and in-county use may used interchangeably and mean the geographic boundary of Butte County.

	60	27,500
	65	27,500
	70	27,500
	75	27,500
	80	27,500
	85	27,500
	90	27,500
	95	27,500
	100	27,500

2.2.1 Any use of Butte County's Table A outside of Butte County by way of transfer, exchange, lease or storage shall be subject to the allocation of the entity receiving the water, not the BC Table allocation, and all leases of water referenced herein are governed by Sections 2.3 and 2.4 of this Agreement. All water allocated to Butte County using the BC Table allocation shall be used only in Butte County's service area and delivery and scheduling of such water shall be in accordance with Articles[4] 10 and 12 of its Water Supply Contract. Any additional water resulting from Butte County's increased allocation under the BC Table shall not be available for storage outside of Butte County's service area or for sale to the Turnback Pool pursuant to Article 56 or for sale through any multi-year purchase program that may be developed in the future.

2.2.2 Butte County may only make available for storage outside its service area, or for sale to the Turnback Pool pursuant to Article 56 or any multi-year water purchase program that may be developed in the future, water that would have been allocated to it under Article 18 prior to this Agreement and excluding any additional water resulting from Butte County's increased allocation under the BC Table.

2.2.3 A "Conference Year" is a year in which the current SOD allocation, as it may change during the year, is equal to or less than 20%.

2.2.4 The BC Table uses SOD Allocations divisible by 5. In the event that the SOD Allocation is not divisible by 5, DWR shall interpolate the BC Table in the manner illustrated in this example:

Example: Assume the SOD Allocation is 39%. To interpolate between 35% and

[4] References to an "Article" refer to provisions in the Plaintiff's Water Supply Contract.

40% to determine the BC Table Allocation for 39%, calculate as follows:

35% = 17,875
40% = 19,250
39% = 17,875 + (4/5) (19,250 – 17,875) = **18,975**

2.2.5 If Butte County's actual future in-county demands are more than the amount specified in the above BC Table for Conference Years, Butte County shall be able to request that the Director supply Butte County's minimum demands under the provision in Article 18(a) of the SWP Contract which allows the State to "apportion on some other basis such is required to meet minimum demands for domestic supply, fire protection or sanitation".

2.2.6 Butte County's in-county use shall be limited to 27,500 AF minus the Maximum Leased Table A Amount (see sub-section 2.3.1 below) and minus any DWR approved reduction of Butte County Table A pursuant to Article 7(a). For example, Butte County has contracted for the lease of 24,000 AF beginning in 2012 (see sub-section 2.7 below) with no Table A reduction under Article 7(a). In-County use for the duration of these long-term lease agreements would be limited to a maximum of 3,500 AF absent any DWR approved Article 7(a) reduction.

2.3 Butte County Lease Provisions

2.3.1 **Long Term Lease:** Butte County will be allowed to lease the unused portion of its Maximum Table A Amount to other SWP contractor(s) for a minimum of 5 years, referred to as Maximum Leased Table A Amount, with an option to extend. Leases may continue only to the extent the leased water is not needed to meet in-county demands by Butte County subject to the limitations in the Water Supply Contract as amended by this Settlement Agreement.

2.3.2 **Retention of Table A Amounts:** Butte County retains the right to the Maximum Leased Table A Amount and shall continue to be obligated to pay the annual charges under the Water Supply Contract for its maximum Table A Amount.

2.4 General Lease Provisions

2.4.1 The annual allocated amount of leased water, made available to a lessee, shall be referred to as Annual Leased Table A Allocated Amount and shall be determined as the Maximum Leased Table A Amount times the lessee's allocation percentage. For example, assume:

Maximum Leased Table A Amount = 24,000 AF
SOD Lessee and SOD Allocation = 25%
Given these assumptions, then:
Annual Leased Table A Allocated Amount = 24,000 x 0.25 = 6,000 AF

2.4.2 The Annual Leased Table A Allocated Amount cannot exceed Butte County's Allocation for that year under the BC Table minus the amount that Butte County uses to meet its in-county needs for that year. See attached Exhibit B for example.

2.4.3 Consistent with past practice, DWR shall not be obligated to deliver the leased water at such times when delivery of water would adversely impact SWP operations, facilities, or other SWP contractors.

2.4.4 The Annual Leased Table A Allocated Amount will be adjusted to zero, and therefore will not be available for delivery, during any year that the DWR Director allocates water pursuant to Article 18(a) of the SWP Contract to meet minimum demands for domestic supply, fire protection, or sanitation.

2.4.5 Priorities under Article 12(f) and implementation of Article 21 shall apply to the Annual Leased Table A Allocated Amount in a manner similar to the lessee's Table A Amounts.

2.4.6 The Maximum Leased Table A Amount shall not be considered part of the lessee's Table A Amounts as it relates to conservation storage provided under Article 56(c), or carry-over entitlement under Article 12(e), nor as it is related to rescheduled water provided under Article 14(b).

2.4.7 The Maximum Leased Table A Amount will not be subject to retroactive or prospective transportation minimum and capital charges.

2.4.8 No long-term lease can be initiated until CEQA is completed.

2.5 DWR Facilitation of Leases: Pursuant to this Settlement Agreement, DWR will help facilitate Butte County in Table A leases between Butte County and other SWP contractor(s).

2.6 Precedent: The above lease provisions are uniquely tied to the settlement of a bona fide legal dispute and are not to be construed as a precedent for or against any other future leases by any other SWP contractor.

2.7 Current Lease Agreements: Butte County has negotiated lease agreements with Palmdale Water District and the Westside Districts for the lease of a portion of Butte County's annual Table A amount for up to ten years

beginning in 2012. DWR has agreed to approve the leases for 2012 and 2013 subject to completion of CEQA compliance for the leases, and signature on the Agreements in Principle by all Plaintiffs in *SCWA v. DWR*. DWR's approval of the leases herein for the years 2014 through 2021 and any 5-year extension thereof shall be subject to the approval of this Agreement by all parties to this Action and its implementation, and all lease extensions shall terminate on December 31, 2035.

2.8 Limitations on Additional Water Supplies: Except as expressly provided for herein, in consideration of the mutual agreements contained in this Agreement, and for the term of the existing SWP Contract and any renewal thereof (including during or as a result of any contract extension negotiations), Butte County agrees to the following limitations:

2.8.1 Butte County shall not claim any preference or priority under Article 18(a) of the existing SWP Contract between Butte County and the State of California.

2.8.2 After January 1, 2027, Butte County may request an amended SWP Contract to increase Butte County's existing total maximum Table A amounts, pursuant to Article 18(c) of its existing SWP long-term water supply contract, provided the following conditions are met:

(i) Butte County will give DWR five years advance notice of its decision to request an increase in its Maximum Table A Amount. During the five year period, Butte County will need to demonstrate that it has fully contracted with water purveyors in Butte County for its Maximum Table A Amount for use within its service area.

(ii) Butte County's current SWP Contract Table A amount and the additional Table A amount (BC Table) must be for use within Butte County's service area.

(iii) As of the effective date of the requested increase, no Table A water, including the original Table A amount, is being leased outside Butte County except through the Turnback pool.

(iv) Butte County pays all retroactive and prospective charges for the additional Table A (BC Table) amount like those that would be applied to other contractors seeking the same contract.

(v) The formulas set forth in the BC Table shall be proportionately applied to the increased Table A amount.

2.8.3 Prior to January 1, 2027, Butte County shall not file a water rights application with the State Water Resources Control Board ("SWRCB") to meet the existing or future water demands within Butte County's service area. Butte County is an inbasin user. Should Butte County file an application after January 1, 2027, and be issued a water right by the SWRCB, Butte County would have, if determined by the SWRCB, an inbasin entitlement. Butte County stipulates that it will not claim a preferential right to use SWP storage under that application or to obtain a storage right or the right to stored water in any SWP storage facility. Butte County further stipulates that any water right issued on such application will provide that when the SWRCB has provided notice that Term 91 is in effect, Butte County shall not be entitled to divert water from streams tributary to the Sacramento-San Joaquin Delta while Term 91 remains in effect.

2.8.4 Butte County shall not claim under the Area-of-Origin or County-of-Origin laws, or any other legal authority, a preferential right to water stored in SWP facilities or a preferential right to contract for the use of SWP storage facilities.

2.8.5 The time limitations in sub-sections 2.8.2 and 2.8.3 shall not apply if a catastrophic event or Act of God causes a substantial failure in one or more of Butte County's existing or future water supplies intended to serve existing or future water demands within Butte's service area.

2.8.6 Nothing herein shall limit or prohibit Butte County from acquiring or purchasing SWP Table A amounts from another SWP Contractor. Any SWP Table A amounts acquired from another SWP contractor shall retain the allocation associated with the original SWP contractor.

2.8.7 In the event that Butte County files a water right application as provided for in sub-sections 2.8.3 or 2.8.5, or requests a new or separate state water contact to increase Butte County's existing total maximum Table A amount as provided for in sub-section 2.8.2 and 2.8.5, or Butte County's SWP Contract is no longer in effect, then:

(i) Butte County has not waived any claim of right associated with the Area of Origin or County of Origin laws, and

(ii) DWR and Intervenors have not waived any right to challenge or protest any such claims of right.

2.9 Director Discretion. If compliance with a legal mandate or the provisions of this Agreement requires exercise of the Director's discretion, such discretion is expressly reserved.

2.10 Opinions and Determinations. Consistent with Article 38 of the SWP Contracts, where the terms of this Agreement provide for action to be based upon the opinion, approval, review, or determination of any party, such terms are not intended to be and shall never be construed as permitting such opinion, approval, review, or determination to be arbitrary, capricious, or unreasonable.

3. Conditions Precedent. This Agreement is not effective until all of the following have occurred:

3.1 Other Agreements. Settlement Agreements for each of the three other Plaintiffs in the Action shall have been fully executed.

3.2 Court Approval. The Sacramento County Superior Court shall have issued an order approving this Agreement and the three other Settlement Agreements.

3.3 Legal Compliance. Implementation of this Agreement is subject to compliance with all environmental or other legal requirements mandated by law. DWR shall comply with the California Environmental Quality Act.

3.4 Dismissal. Butte County will dismiss with prejudice the First Amended Complaint filed on February 27, 2009. All Parties agree that the only claims raised in the First Amended Complaint are claims relating to the applicability of SWP Contract Article 18(a) shortages to Plaintiffs. While not addressed in the First Amended Complaint, the Parties' agreements regarding Plaintiffs' claims of rights pursuant to Water Code Sections 11460 et seq. or Water Code Section 10505 that may exist independent of the SWP Contract, and claims of rights pursuant to Article 18(c) of the SWP Contract, are addressed in Section 2.8 of this Agreement.

3.5 Notice to Contractors. The Deputy Director for DWR will execute and distribute the Notice to State Water Project Contractors providing an Informational Bulletin on Various Contracts for Project Water, attached hereto as Exhibit C.

4. No Precedent. Nothing in this Agreement is precedent for any future action by DWR or any of the Parties.

5. Default and Remedies.

5.1 If Butte County files an application with the SWRCB prior to 2027 or requests an Article 18(c) contract prior to 2027, except as allowed by sub-section 2.8.5, this is deemed a breach. DWR will hold all benefits under this

Settlement Agreement for Butte in abeyance until Butte cures the breach by withdrawing the application or contract request.

5.2 If any Party to this Agreement breaches, the Parties agree that monetary damages alone would be insufficient. Any non-breaching party can request specific performance, including but not limited to injunctive relief, fourteen (14) days after providing notice of the alleged breach to other Parties as provided in Section 5.3 below.

5.3 In the event of an alleged breach, the non-breaching Party agrees to give notice of the alleged breach to all other parties to the Agreement and to consult with the Parties for the purpose of attempting in good faith to resolve any disputes prior to the initiation of litigation or court proceedings.

5.4 The use by the Parties of any remedy specified herein for the enforcement of the Agreement is not exclusive and shall not deprive either from using any other remedy provided by law.

5.5 In any action by any of the Parties to enforce or interpret the Agreement, the prevailing party is entitled to attorney fees and costs, including expert costs.

5.6 If Butte County breaches the Agreement, the limitation provisions in sub-section 2.8 will survive as against Butte County.

6. Attorneys Fees and Costs. All Parties agree to bear their own fees and costs associated with the Action or any challenges by any non-party to the Settlement Agreement and related implementing documents.

7. Superior Court to Enforce Agreement. The Parties agree and acknowledge that this Agreement shall be deemed to have been entered into by and between the Parties in the County of Sacramento, State of California. The Parties agree that the Superior Court of California for the County of Sacramento , in which forum the Action was filed, shall be the judicial forum for purposes of jurisdiction should any Party seek to enforce the terms of this Agreement.

8. No Admission. This Agreement and its provisions and any proceedings taken hereunder are for settlement purposes only and are not intended to be, and shall not in any event be construed or deemed to be, a concession on the part of the Parties, or any of them, of any liability or wrongdoing whatsoever or of any conceded interpretation of the Area of Origin Statutes. This Agreement is predicated upon unique facts which exist between the Parties and none of the Parties intend this Agreement to be a waiver of any right or position in regards to any third party. Neither this Agreement nor any negotiations or proceedings in pursuance of this Agreement shall be offered or received in any action or proceeding as an admission or concession of liability or wrongdoing of any nature on the part of the Parties, or any of them, or anyone acting on their respective behalves.

9. Successors. This Agreement shall be binding upon and inure to the benefit of the Parties hereto and their respective representatives, successors and assigns. No Party may assign its rights under this Agreement without the prior written consent of the other Parties.

10. Notice. Unless and until the Parties otherwise agree in writing, all communications and notice between the Parties regarding this Agreement shall be through the following addresses:

PLAINTIFFS:

Butte County

Chief Administrative Officer, Butte County
25 County Center Drive
Oroville CA. 95965

County Counsel, Butte County
25 County Center Drive
Oroville CA 95965

INTERVENORS:

Alameda County Flood Control & Water Conservation District, Zone 7

Attention: General Manager
100 North Canyons Parkway
Livermore, CA 94551
(925) 454-5000
(925) 454-5729 [fax]

Alameda County Water District

Walt Wadlow, General Manager
43885 South Grimmer Boulevard
Fremont, CA 94538
(510) 668-4200

Antelope Valley-East Kern Water Agency

Dan Flory, General Manager
6500 West Avenue N
Palmdale, CA 93551
(661) 943-3201
(661) 943-3204 [fax]

Castaic Lake Water Agency

Dan Masnada, General Manager
27234 Bouquet Canyon Road
Santa Clarita, CA 93150
(661) 297-1600
dmasnada@clwa.org

Central Coast Water Authority

Bill Brennan, Executive Director
255 Industrial Way
Buellton, CA 93427
(805) 688-2292, ext. 215
(805) 686-4700 (fax)
wjb@ccwa.com

Coachella Valley Water District

Attention: General Manager
P.O. Box 1058
Coachella, CA 92236
Phone (760) 398-2651
Fax (760) 398-3711

Kern County Water Agency

Jim Beck, General Manager
Post Office Box 58
Bakersfield, CA 93302-0058
(661) 634-1400
(661) 634-1428 [fax]

Metropolitan Water District of Southern California

Jeff Kightlinger, General Manager
Post Office Box 54153
Los Angeles, CA 90054-0153
(213) 217-6308 - Legal Department, General

Mojave Water Agency

Kirby Brill, General Manager
13846 Conference Center Drive
Apple Valley, CA 92307
(760) 946-7000
(760) 946-7008 [direct]

Palmdale Water District

Dennis LaMoreaux, General Manager
2029 East Ave., Q
Palmdale CA, 93550
(661)947-1111
(661) 456-1017 [direct]

San Gorgonio Pass Water Agency

Jeff Davis, General Manager
1210 Beaumont Ave.
Beaumont, CA 92223
(951) 845-2577
(951) 845-0281 [fax]

Santa Clara Valley Water District

Beau Goldie, Chief Executive Officer
5750 Almaden Expressway
San Jose, CA 95118-3686
(408) 265-2600

Tulare Lake Basin Water Storage District

Mark Gilkey, General Manager
1001 Chase Ave
Corcoran, CA 93212
(559) 992-4127

Department of Water Resources

Robert Cooke, P.E
Chief, State Water Project Analysis Office
Department of Water Resources
1416 9th Street, 16th Floor
Sacramento, CA 95814

11. Further Cooperation. The Parties, and each of them, agree to do all things reasonably necessary to implement this Agreement, including, but not limited to, executing such additional writings as may be reasonably required to carry out the intent of this Agreement. The Parties will reasonably cooperate, each with the other, to effectuate the purpose of this Agreement, to protect and defend its integrity and do what may be necessary to verify its existence and operation in such matters as may be relevant.

12. Entire Agreement. This Agreement constitutes the entire agreement between the Parties. There are no further or other agreements or understandings, written or oral, in effect between the Parties relating to the subject matter of this Agreement.

13. Modification of Agreement. It is expressly understood and agreed that this Agreement may not be altered, amended, modified, or otherwise changed in any respect whatsoever except by a writing duly executed by authorized representatives of the Parties hereto. The Parties hereby agree and acknowledge that they will make no claim at any time or place that this Agreement has been orally altered or modified or otherwise changed by oral communication of any kind or character.

14. Mutual Preparation. The Parties each cooperated in the drafting and preparation of this Agreement and thus it shall be deemed drafted by all Parties to the Agreement. The language of all parts of this Agreement shall be construed as a whole, according to its fair meaning, and not strictly for or against any Party as the drafter thereof.

15. Authority. Each Party respectively represents and warrants to each other Party that the undersigned representative for such Party has full and complete authority to execute and enter into this Agreement and bind said Party to the terms hereof.

16. Counterparts. This Agreement may be executed by facsimile and in counterparts, and each counterpart shall be considered an original, and all of which, taken together, shall constitute one and the same instrument; provided, however, that original signatures will also be provided to all counsel by mail.

17. Captions. The captions contained herein are intended solely for convenience and shall not be construed as full or accurate descriptions of the terms hereof.

18. Independent Investigation. Each Party has made such investigation of the facts pertaining to this Agreement and of all matters pertaining thereto as it deems necessary.

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19. Voluntary and Knowing Execution. Each Party respectively represents and warrants to each other Party that it has thoroughly read and considered all aspects of this Agreement, that it understands all provisions of this Agreement, that it has had the opportunity to consult with counsel, and that it is voluntarily and knowingly entering into this Agreement without duress or coercion of any kind.

SO AGREED:

Plaintiff:

Bill Connelly 8 Oct 2013

Butte County Date

Chair, Butte County
Board of Supervisors

Defendant:

1/6/14

Mark W. Cowin, Director Date

Department of Water Resources

12/19/13

Approved as to Legal Form Date

and Sufficiency

for Cathy Crothers, Chief Counsel

Department of Water Resources

Intervenors:

Metropolitan Water District of Southern California	Date	Alameda County Flood Control & Water Conservation District, Zone 7	Date
Alameda County Water District	Date	Antelope Valley-East Kern Water Agency	Date
Castaic Lake Water Agency	Date	Central Coast Water Authority	Date

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SO AGREED:

Plaintiff:

Butte County Date

Defendant:

Mark W. Cowin, Director Date
Department of Water Resources

Approved as to Legal Form Date
and Sufficiency
Cathy Crothers, Chief Counsel
Department of Water Resources

Intervenors:

9/24/13

Metropolitan Water District of Southern California — Date	Alameda County Flood Control & Water Conservation District, Zone 7 — Date
Alameda County Water District — Date	Antelope Valley-East Kern Water Agency — Date
Castaic Lake Water Agency — Date	Central Coast Water Authority — Date

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SO AGREED:

Plaintiff:

Butte County Date

Defendant:

Mark W. Cowin, Director Date
Department of Water Resources

Approved as to Legal Form Date
and Sufficiency
Cathy Crothers, Chief Counsel
Department of Water Resources

Intervenors:

Metropolitan Water District of Southern California Date

G. F. Duerig, General Manager
9/18/13
Alameda County Flood Control & Water Conservation District, Zone 7 Date

Alameda County Water District Date

Antelope Valley-East Kern Water Agency Date

Castaic Lake Water Agency Date

Central Coast Water Authority Date

19. Voluntary and Knowing Execution. Each Party respectively represents and warrants to each other Party that it has thoroughly read and considered all aspects of this Agreement, that it understands all provisions of this Agreement, that it has had the opportunity to consult with counsel, and that it is voluntarily and knowingly entering into this Agreement without duress or coercion of any kind.

SO AGREED:

Plaintiff:

Butte County	Date

Defendant:

Mark W. Cowin, Director Department of Water Resources	Date
Approved as to Legal Form and Sufficiency Cathy Crothers, Chief Counsel Department of Water Resources	Date

Intervenors:

Metropolitan Water District of Southern California	Date	Alameda County Flood Control & Water Conservation District, Zone 7	Date
Walter L. Wadlow Alameda County Water District	9/17/13 Date	Antelope Valley-East Kern Water Agency	Date
Castaic Lake Water Agency	Date	Central Coast Water Authority	Date

19. Voluntary and Knowing Execution. Each Party respectively represents and warrants to each other Party that it has thoroughly read and considered all aspects of this Agreement, that it understands all provisions of this Agreement, that it has had the opportunity to consult with counsel, and that it is voluntarily and knowingly entering into this Agreement without duress or coercion of any kind.

SO AGREED:

Plaintiff:

Butte County	Date

Defendant:

Mark W. Cowin, Director Department of Water Resources	Date
Approved as to Legal Form and Sufficiency Cathy Crothers, Chief Counsel Department of Water Resources	Date

Intervenors:

Metropolitan Water District of Southern California	Date	Alameda County Flood Control & Water Conservation District, Zone 7	Date
Alameda County Water District	Date	Keith Dyk Antelope Valley-East Kern Water Agency	10/22/13 Date
Castaic Lake Water Agency	Date	Central Coast Water Authority	Date

19. Voluntary and Knowing Execution. Each Party respectively represents and warrants to each other Party that it has thoroughly read and considered all aspects of this Agreement, that it understands all provisions of this Agreement, that it has had the opportunity to consult with counsel, and that it is voluntarily and knowingly entering into this Agreement without duress or coercion of any kind.

SO AGREED:

Plaintiff:

Butte County — Date

Defendant:

Mark W. Cowin, Director — Date
Department of Water Resources

Approved as to Legal Form and Sufficiency — Date
Cathy Crothers, Chief Counsel
Department of Water Resources

Intervenors:

Metropolitan Water District of Southern California — Date

Alameda County Flood Control & Water Conservation District, Zone 7 — Date

Alameda County Water District — Date

Antelope Valley-East Kern Water Agency — Date

9/26/13

Castaic Lake Water Agency — Date

Central Coast Water Authority — Date

19. Voluntary and Knowing Execution. Each Party respectively represents and warrants to each other Party that it has thoroughly read and considered all aspects of this Agreement, that it understands all provisions of this Agreement, that it has had the opportunity to consult with counsel, and that it is voluntarily and knowingly entering into this Agreement without duress or coercion of any kind.

SO AGREED:

Plaintiff:

Butte County	Date

Defendant:

Mark W. Cowin, Director Department of Water Resources	Date
Approved as to Legal Form and Sufficiency Cathy Crothers, Chief Counsel Department of Water Resources	Date

Intervenors:

Metropolitan Water District of Southern California	Date	Alameda County Flood Control & Water Conservation District, Zone 7	Date
Alameda County Water District	Date	Antelope Valley-East Kern Water Agency	Date
Castaic Lake Water Agency	Date	Central Coast Water Authority	9-23-13 Date

Coachella Valley Water District	9.23.13 Date	Kern County Water Agency	Date
Mojave Water Agency	Date	Palmdale Water District	Date
San Gorgonio Pass Water Agency	Date	Santa Clara Valley Water District	Date
Tulare Lake Basin Water Storage District	Date		

Coachella Valley Water District	Date	Kern County Water Agency	10/24/13 Date
Mojave Water Agency	Date	Palmdale Water District	Date
San Gorgonio Pass Water Agency	Date	Santa Clara Valley Water District	Date
Tulare Lake Basin Water Storage District	Date		

Coachella Valley Water District	Date	Kern County Water Agency	Date
Mojave Water Agency	10/2/13 Date	Palmdale Water District	Date
San Gorgonio Pass Water Agency	Date	Santa Clara Valley Water District	Date
Tulare Lake Basin Water Storage District	Date		

Coachella Valley Water District	Date	Kern County Water Agency	Date
Mojave Water Agency	Date	Palmdale Water District	Date 9/25/13
San Gorgonio Pass Water Agency	Date	Santa Clara Valley Water District	Date
Tulare Lake Basin Water Storage District	Date		

Coachella Valley Water District	Date	Kern County Water Agency	Date
Mojave Water Agency	Date	Palmdale Water District	Date
Jeffrey W. Davis San Gorgonio Pass Water Agency	9-15-13 Date	Santa Clara Valley Water District	Date
Tulare Lake Basin Water Storage District	Date		

Coachella Valley Water District	Date	Kern County Water Agency	Date
Mojave Water Agency	Date	Palmdale Water District	Date
San Gorgonio Pass Water Agency	Date	Santa Clara Valley Water District	10-22-13 Date
Tulare Lake Basin Water Storage District	Date		

Coachella Valley Water District	Date	Kern County Water Agency	Date
Mojave Water Agency	Date	Palmdale Water District	Date
San Gorgonio Pass Water Agency	Date	Santa Clara Valley Water District	Date
Tulare Lake Basin Water Storage District	9/19/2013 Date		

EXHIBIT A - FORM OF SWP CONTRACT AMENDMENT

Area of Origin Settlement
Butte County Contract Amendment

STATE OF CALIFORNIA
THE CALIFORNIA NATURAL RESOURCES AGENCY
THE DEPARTMENT OF WATER RESOURCES

AMENDMENT NO. 21 TO WATER SUPPLY CONTRACT
BETWEEN
THE STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES AND
BUTTE COUNTY

THIS AMENDMENT to the Water Supply Contract is entered into on December 31, 2013 pursuant to the provisions of the California Water Resources Development Bond Act, the Central Valley Project Act, and other applicable laws of the State of California, between the State of California, acting by and through its Department of Water Resources (the State) and Butte County (Agency).

RECITALS

A. WHEREAS, on or about July 17, 2008, Agency and other Plaintiffs filed a civil action against the State in the Superior Court of California for the County of Sacramento (the "Court"), Case No. 34-2008-00016338 CU-BC-GDS, and on or about March 2, 2009 the Court granted Intervenors' Motion to Intervene in the action (the complaint and the complaint in intervention are collectively referred to as the "Action", and the parties to the lawsuit are referred to individually as "Party", and collectively as "Parties);

B. WHEREAS, each of the Plaintiffs and Intervenors to said Action has a contract with the State for a supply of water from the State Water Project ("SWP") which existing contracts are referred to as the "SWP Contracts" or "Water Supply Contracts".

C. WHEREAS, the Parties' claims in the Action relate to disputes over the meaning of the Water Supply Contracts regarding Agency and the other Plaintiffs' claimed rights to water under their Contracts pursuant to Water Code section 11460, *et seq.*, and section 10505, commonly referred to as the "area of origin statutes";

D. WHEREAS, each Party disputes the interpretation of the SWP Contracts advanced by the other Parties, and the State and Intervenors dispute whether any of the Plaintiffs have established area of origin rights, and each Party denies that any other Party is entitled to any relief based on the claims alleged in the Action;

E. WHEREAS, the Agency, the State and Intervenors have entered into a Settlement Agreement December 31, 2013, to compromise, resolve, settle, and terminate any and all of the disputes or claims in the Action on terms and conditions set forth therein (the "Settled Disputes and Claims"). The Settled Disputes and Claims include any and all disputes or claims related to whether any Plaintiff is entitled to a preference in water deliveries from the SWP under the terms of the existing SWP Contracts; and

F. Pursuant to Section 2.1 of said Settlement Agreement, the Parties thereto agreed that Agency's Water Supply Contract should be amended to incorporate provisions of the Settlement Agreement, and the State and Agency desire to so amend the Agency's Water Supply Contract.

NOW, THEREFORE, in consideration of the above, it is mutually agreed as follows:

Article 45 (k) is added to the Agency's Water Supply Contract to read:

(k) Provisions Affecting Operations

Notwithstanding anything to the contrary in Article 18, the State shall deliver water to Agency as provided in the *SCWA v. DWR* Settlement Agreement, Sacramento County Superior Court Case No. 34-2008-00016338 CU-BC-GDS, dated Dec. 13, 2013, attached hereto as Exhibit "A", and consistent with the following provisions affecting operations

(1) Butte County Allocation

For purposes of determining available water for Plaintiff under the Water Supply Contract, the State shall first determine the South of Delta ("SOD") allocation and then allocate Butte County's Table A for use in its service area[1] in accordance with the following Butte County Allocation Table ("BC Table"):

Butte County ("BC") Allocation Table

	SOD ALLOCATION (%)	BUTTE COUNTY ALLOCATION (AF)
Conference Years SOD = 0 to 20%	0	3,000
	5	3,000
	10	4,000
	15	5,000
	20	6,000
SOD +	25	15,125

[1] Service area and in-county use may used interchangeably and mean the geographic boundary of Butte County.

	30	16,500
	35	17,875
	40	19,250
	45	20,625
	50	22,000
	55	23,375
	60	27,500
	65	27,500
	70	27,500
	75	27,500
	80	27,500
	85	27,500
	90	27,500
	95	27,500
	100	27,500

(a) Any use of Butte County's Table A outside of Butte County by way of transfer, exchange, lease or storage shall be subject to the allocation of the entity receiving the water, not the BC Table allocation, and all leases of water referenced herein are governed by Sections (2) and (3) of this sub-article(k) . All water allocated to Butte County using the BC Table allocation shall be used only in Butte County's service area and delivery and scheduling of such water shall be in accordance with Articles[2] 10 and 12 of its Water Supply Contract. Any additional water resulting from Butte County's increased allocation under the BC Table shall not be available for storage outside of Butte County's service area or for sale to the Turnback Pool pursuant to Article 56 or for sale through any multi-year purchase program that may be developed in the future.

(b) Butte County may only make available for storage outside its service area, or for sale to the Turnback Pool pursuant to Article 56 or any multi-year water purchase program that may be developed in the future, water that would have been allocated to it under Article 18 prior to this sub-article(k) and excluding any additional water resulting from Butte County's increased allocation under the BC Table.

(c) A "Conference Year" is a year in which the current SOD allocation, as it may change during the year, is equal to or less than 20%.

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[2] References to an "Article" refer to provisions in the Plaintiff's Water Supply Contract.

(d) The BC Table uses SOD Allocations divisible by 5. In the event that the SOD Allocation is not divisible by 5, the State shall interpolate the BC Table in the manner illustrated in this example:

Example: Assume the SOD Allocation is 39%. To interpolate between 35% and 40% to determine the BC Table Allocation for 39%, calculate as follows:

35% = 17,875
40% = 19,250
39% = 17,875 + (4/5) (19,250 – 17,875) = **18,975**

(e) If Butte County's actual future in-county demands are more than the amount specified in the above BC Table for Conference Years, Butte County shall be able to request that the Director supply Butte County's minimum demands under the provision in Article 18(a) of the SWP Contract which allows the State to "apportion on some other basis such is required to meet minimum demands for domestic supply, fire protection or sanitation".

(f) Butte County's in-county use shall be limited to 27,500 AF minus the Maximum Leased Table A Amount (see sub-section 2.3.1 below) and minus any State-approved reduction of Butte County Table A pursuant to Article 7(a). For example, Butte County has contracted for the lease of 24,000 AF beginning in 2012 (see sub-section 2.7 below) with no Table A reduction under Article 7(a). In-County use for the duration of these long-term lease agreements would be limited to a maximum of 3,500 AF absent any State-approved Article 7(a) reduction.

(2) Butte County Lease Provisions

(a) <u>Long Term Lease:</u> Butte County will be allowed to lease the unused portion of its Maximum Table A Amount to other SWP contractor(s) for a minimum of 5 years, referred to as Maximum Leased Table A Amount, with an option to extend. Leases may continue only to the extent the leased water is not needed to meet in-county demands by Butte County subject to the limitations in the Water Supply Contract as amended.

(b) <u>Retention of Table A Amounts:</u> Butte County retains the right to the Maximum Leased Table A Amount and shall continue to be obligated to pay the annual charges under the Water Supply Contract for its maximum Table A Amount.

(3) General Lease Provisions

(a) The annual allocated amount of leased water, made available to a lessee, shall be referred to as Annual Leased Table A Allocated Amount and shall

be determined as the Maximum Lease Table A Amount times the lessee's allocation percentage. For example, assume:

Maximum Leased Table A Amount = 24,000 AF
SOD Lessee and SOD Allocation = 25%
Given these assumptions, then:
Annual Leased Table A Allocated Amount = 24,000 x 0.25 = 6,000 AF

(b) The Annual Leased Table A Allocated Amount cannot exceed Butte County's Allocation for that year under the BC Table minus the amount that Butte County uses to meet its in-county needs for that year. See attached Exhibit B for example.

(c) Consistent with past practice, the State shall not be obligated to deliver the leased water at such times when delivery of water would adversely impact SWP operations, facilities, or other SWP contractors.

(d) The Annual Leased Table A Allocated Amount will be adjusted to zero, and therefore will not be available for delivery, during any year that the State's Director allocates water pursuant to Article 18(a) of the SWP Contract to meet minimum demands for domestic supply, fire protection, or sanitation.

(e) Priorities under Article 12(f) and implementation of Article 21 shall apply to the Annual Leased Table A Allocated Amount in a manner similar to the lessee's Table A Amounts.

(f) The Maximum Leased Table A Amount shall not be considered part of the lessee's Table A Amounts as it relates to conservation storage provided under Article 56(c), or carry-over entitlement under Article 12(e) nor as it is related to rescheduled water provided under Article 14(b).

(g) The Maximum Leased Table A Amount will not be subject to retroactive or prospective transportation minimum and capital charges.

(h) No long-term lease can be initiated until CEQA is completed.

(4) State Facilitation of Leases

Pursuant to the Settlement Agreement, the State will help facilitate Butte County in Table A leases between Butte County and other SWP contractor(s).

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(5) Precedent

The above lease provisions are uniquely tied to the settlement of a bona fide legal dispute and are not to be construed as a precedent for or against any other future leases by any other SWP contractor.

(6) Current Lease Agreements

Butte County has negotiated lease agreements with Palmdale Water District and the Westside Districts for the lease of a portion of Butte County's annual Table A amount for up to ten years beginning in 2012. The State has agreed to approve the leases for 2012 and 2013 subject to completion of CEQA compliance for the leases, and signature on the Agreements in Principle by all Plaintiffs in *SCWA v. DWR*. The State's approval of the leases herein for the years 2014 through 2021 and any 5-year extension thereof shall be subject to the approval of the Settlement Agreement by all parties to this Action, and its implementation and all lease extensions shall terminate on December 31, 2035.

(7) Limitations on Additional Water Supplies

Except as expressly provided for herein, in consideration of the mutual agreements contained in the Settlement Agreement, and for the term of the existing SWP Contract and any renewal thereof (including during or as a result of any contract extension negotiations), Butte County agrees to the following limitations:

(a) Butte County shall not claim any preference or priority under Article 18(a) of the existing SWP Contract between Butte County and the State of California.

(b) After January 1, 2027, Butte County may request an amended SWP Contract to increase Butte County's existing total maximum Table A amounts, pursuant to Article 18(c) of its existing SWP long-term water supply contract, provided the following conditions are met:

(i) Butte County will give the State five years advance notice of its decision to request an increase in its Maximum Table A Amount. During the five-year period, Butte County will need to demonstrate that it has fully contracted with water purveyors in Butte County for its Maximum Table A Amount for use within its service area.

(ii) Butte County's current SWP Contract Table A amount and the additional Table A amount (BC Table) must be for use within Butte County's service area.

(iii) As of the effective date of the requested increase, no Table A water, including the original Table A amount, is being leased outside Butte County except through the Turnback pool.

(iv) Butte County pays all retroactive and prospective charges for the additional Table A (BC Table) amount like those that would be applied to other contractors seeking the same contract.

(v) The formulas set forth in the BC Table shall be proportionately applied to the increased Table A amount.

(c) Prior to January 1, 2027, Butte County shall not file a water rights application with the State Water Resources Control Board ("SWRCB") to meet the existing or future water demands within Butte County's service area. Butte County is an inbasin user. Should Butte County file an application after January 1, 2027, and be issued a water right by the SWRCB, Butte County would have, if determined by the SWRCB, an inbasin entitlement. Butte County stipulates that it will not claim a preferential right to use SWP storage under that application or to obtain a storage right or the right to stored water in any SWP storage facility. Butte County further stipulates that any water right issued on such application will provide that when the SWRCB has provided notice that Term 91 is in effect, Butte County shall not be entitled to divert water from streams tributary to the Sacramento-San Joaquin Delta while Term 91 remains in effect.

(d) Butte County shall not claim under the Area-of-Origin or County-of-Origin laws, or any other legal authority, a preferential right to water stored in SWP facilities or a preferential right to contract for the use of SWP storage facilities.

(e) The time limitations in sub-sections (7)(b) and (7)(c) shall not apply if a catastrophic event or Act of God causes a substantial failure in one or more of Butte County's existing or future water supplies intended to serve existing or future water demands within Butte's service area.

(f) Nothing herein shall limit or prohibit Butte County from acquiring or purchasing SWP Table A amounts from another SWP Contractor. Any SWP Table A amounts acquired from another SWP contractor shall retain the allocation associated with the original SWP contractor.

(g) In the event that Butte County files a water right application as provided for in sub-sections (7)(c) and (7)(e), or requests a new or separate state water contact to increase Butte County's existing total maximum Table A amount as provided for in sub-section (7)(b) and (7)(e), or Butte County's SWP Contract is no longer in effect, then:

(i) Butte County has not waived any claim of right associated with the Area of Origin or County of Origin laws, and

(ii) The State and Intervenors have not waived any right to challenge or protest any such claims of right.

(8) Director Discretion

If compliance with a legal mandate or the provisions of this sub-article 45(k) requires exercise of the Director's discretion, such discretion is expressly reserved.

(9) Opinions and Determinations

Consistent with Article 38 of the SWP Contracts, where the terms of this sub-article 45(k) provide for action to be based upon the opinion, approval, review, or determination of any party, such terms are not intended to be and shall never be construed as permitting such opinion, approval, review, or determination to be arbitrary, capricious, or unreasonable.

(10) Default and Remedies

If Agency files an application with the SWRCB prior to 2027 or requests an Article 18(c) contract prior to 2027, except as allowed by sub-section 7(e), this is deemed a breach. The State will hold all benefits for Agency under the Settlement Agreement in abeyance until Agency cures the breach by withdrawing the application or contract request.

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(11) Modification of Sub-article 45(k)

It is expressly understood and agreed that this sub-article 45(k) may not be altered, amended, modified, or otherwise changed in any respect whatsoever except by a writing duly executed by authorized representatives of Agency, the State and Intervenors in the Action. The Parties hereby agree and acknowledge that they will make no claim at any time or place that this sub-article 45(k) has been orally altered or modified or otherwise changed by oral communication of any kind or character.

IN WITNESS WHEREOF, the Parties hereto have executed this amendment on the date first written above.

Approved as to legal form
and sufficiency:

for Cathy Crothers, Chief Counsel
Department of Water Resources

STATE OF CALIFORNIA
DEPARTMENT OF WATER
RESOURCES

Mark W. Cowin, Director

BUTTE COUNTY

Bill Connelly
Name
Chair, Butte County
Board of Supervisors
Title

EXHIBIT B – EXAMPLE MAXIMUM BC TABLE AMOUNT AVAILABLE FOR LEASE

(1) Table A SOD Allocation (%)	(2) Existing Conditions (Table A Allocation) (af)	(3) BC Table Allocation (af)	(4) Maximum BC Table Amount Available for In-county Use (af)	(5) Maximum Amount Available for Lease (af)
0	0	3,000	3,000	0
5	1,375	3,000	3,000	0
10	2,750	4,000	3,500	500
15	4,125	5,000	3,500	1,500
20	5,500	6,000	3,500	2,500
25	6,875	15,125	3,500	6,000
30	8,250	16,500	3,500	7,200
35	9,625	17,875	3,500	8,400
40	11,000	19,250	3,500	9,600
45	12,375	20,625	3,500	10,800
50	13,750	22,000	3,500	12,000
55	15,125	23,375	3,500	13,200
60	16,500	27,500	3,500	14,400
65	17,875	27,500	3,500	15,600
70	19,250	27,500	3,500	16,800
75	20,625	27,500	3,500	18,000
80	22,000	27,500	3,500	19,200
85	23,375	27,500	3,500	20,400
90	24,750	27,500	3,500	21,600
95	26,125	27,500	3,500	22,800
100	27,500	27,500	3,500	24,000

Notwithstanding the amounts reflected in Column 5 above, the Maximum BC Table Amount Available for lease will be adjusted to zero in and during any year that the DWR Director allocates water pursuant to Article 18(a) of the State Water Project Contract to meet minimum demands for domestic supply, fire protection, or sanitation. Any use of Butte County's Table A outside of Butte County by way of transfer, exchange, lease or storage shall be subject to the allocation of the entity receiving the water, not the BC Table allocation, and all leases of water referenced herein are governed by Sections 2.3 and 2.4 of the Settlement Agreement. All water allocated to Butte County using the BC Table allocation shall be used only in Butte County's service area and delivery and scheduling of such water shall be in accordance with Articles 10 and 12 of its Water Supply Contract.

Exhibit B Table provides an example of the maximum amount of Butte County's Table A that would be available for lease for a given Butte County in-county use. Column 1 lists the range of possible State Water Project allocations to South-of-Delta (SOD) contractors and assumes the current State Water Project SOD allocation methodology. Column 2 shows the corresponding Butte County Table A Allocation assuming a given SWP allocation percentage in Column 1. Column 3 is the allocation for Butte County as identified in Section 2.2 of the Settlement Agreement. Column 4 is an example of Butte County's maximum in-county use; in this case, it is assumed to be 3,500 af as discussed below. However, when the Table A SOD Allocation is 5% or less under Column 1, this amount would be limited to 3,000 af pursuant to the BC Allocation Table, which is also the value in Column 4. The Maximum Leased Table A Amount to be leased to SOD contractors is 24,000 af. However, the amount that is made available in any single year for lease cannot exceed Column 3 minus the amount that Butte County uses to meet its in-county needs. The assumed 3,500 af in-county use amount consists of a current in-county contracted demand of 2,668 af and 832 af of water that is held in reserve. This Settlement Agreement enables Butte County to lease a portion of its Table A Amount to other State Water Project contractors. Butte County has entered into agreements for the lease of 14,000 af to the Westside Districts in the San Joaquin Valley that currently receive SWP water and 10,000 af to Palmdale Water District in 2014–2021 with options for multiple 5-year extensions thereafter.

The maximum amount leased may be above or below 24,000 af each year, depending upon the in-county demand and the SOD allocation for that year. Column 5 is an example of the maximum amount that can be leased based on the SOD allocation in Column 1 and the maximum in-county use of either 3,000 af or 3,500 af in Column 4. If Butte County's actual demand is lower than its maximum in-county use (for example, lower than 3,500 af) in any year, the unused amount would be available to add to the Maximum Lease amount in that year. For example, in 2012 and 2013, the actual maximum in-county use is 2,668 af allowing for a temporary increase of 832 af to the Maximum Leased Table A Amount or 24,832 af total. Using the allocation shown in the Exhibit B Table and assuming a 3,500 af in-county contract amount and a 40% SOD allocation, a total of 9,600 af (24,000 af * 40%) would be delivered to SOD contractors. However, if the actual in-county use is only 2,668 af, the corresponding Maximum Lease Table A Amount is adjusted to 24,832 af (24,000 af + [3,500 af – 2,668 af]). The amount available for delivery to Butte County's SOD lessees would be 9,932.80 af (24,832 af * 40%).

EXHIBIT C – NOTICE TO CONTRACTORS

STATE OF CALIFORNIA • NATURAL RESOURCES AGENCY
• DEPARTMENT OF WATER RESOURCES

NOTICE TO

STATE WATER PROJECT CONTRACTORS

NUMBER: **13-15** **DATE:** DEC 3 1 2013

SUBJECT: Informational Bulletin on Various Contracts for Project Water

FROM:
DEPUTY DIRECTOR,
DEPARTMENT OF WATER RESOURCES

The Department of Water Resources may consider various contractual approaches to provide water to requesting entities. Possible approaches would include entering into a new or amended State Water Project Long-Term Water Supply Contract. In considering future requests for water supply and in developing any new agreements for water supply, DWR generally will apply the following principles:

a. The quantity of water to be provided will be limited to that amount needed to meet the demonstrated needs within the entity's service area and also limited to that amount that the entity could reasonably be expected to be established by an application to appropriate water filed with the SWRCB under the provisions of Water Code sections 11460 through 11463.

b. For entities with existing SWP Contracts, it will not receive a new or amended SWP Contract that would increase its existing total maximum Table A Allocation, if any, unless and until it is fully utilizing its current SWP Contract Table A Allocation within its service area.

c. An entity will pay its proportionate share of all retroactive and prospective costs of conservation facilities and applicable transportation facilities, including the payment of interest thereon.

d. The Contract will be subject to the uniformity requirements applicable to the existing SWP Contracts, such that the terms and conditions of the Contract will be substantially uniform with the basic terms and conditions of existing SWP Contracts, and specifically will be subject to the uniform shortage provisions contained in Article 18(a) of existing SWP Contracts.

EXHIBIT C
THE CITY OF NAPA'S
ADDENDUM TO THE SETTLEMENT AGREEMENT AND RELEASE

THIS ADDENDUM TO THE SETTLEMENT AGREEMENT AND RELEASE is approved and entered into by the City of Napa, a Participating Agency of the Napa County Flood Control and Water Conservation District ("Plaintiff" or "Napa").

RECITALS

A. WHEREAS, on or about July 17, 2008, Napa and other Plaintiffs filed a civil action against the Department of Water Resources ("DWR") in the Superior Court of California for the County of Sacramento (the "Court"), Case No. 34-2008-00016338 CU-BC-GDS, and on or about March 2, 2009 the Court granted Intervenors'[1] Motion to Intervene in the action (the complaint and the complaint in intervention are collectively referred to as the "Action");

B. WHEREAS, Napa and each of the other Plaintiffs and Intervenors has a contract with DWR for a supply of water from the State Water Project ("SWP") which existing contracts are referred to as the "SWP Contracts" or "Water Supply Contracts";

C. WHEREAS, the Plaintiffs, DWR, and Intervenors (collectively "Parties") claims in the Action relate to disputes over the meaning of the Water Supply Contracts regarding Plaintiffs' claimed rights to water under their Contracts pursuant to Water Code section 11460, *et seq.*, and section 10505, commonly referred to as the "area of origin statutes";

D. WHEREAS, each Party disputes the interpretation of the SWP Contracts advanced by the other Parties, and DWR and Intervenors dispute whether any of the Plaintiffs have established area of origin rights and each Party denies that any other Party is entitled to any relief based on the claims alleged in the Action;

E. WHEREAS, the Parties wish to compromise, resolve, settle, and terminate any and all of the disputes or claims in the Action on terms and conditions set forth herein (the "Settled Disputes and Claims"). The Settled Disputes and Claims include any and all disputes or claims related to whether any Plaintiff is entitled to a preference in water deliveries from the SWP under the terms of the existing SWP Contracts;

F. WHEREAS, the Parties and Participating Agency represent that they understand they are waiving significant legal rights by signing the Settlement Agreement and Release and this Addendum, and each Party in no way admits responsibility for debts, liability, and/or obligations owed to any other Party or third parties, and this Agreement is made in a spirit of compromise for the sole purpose of avoiding the uncertainties and expenses of litigation with respect to the Settled Disputes and Claims;

[1] The Intervenors include the following State Water Project ("SWP") contractors: Alameda County Flood Control and Water Conservation District, Zone 7; Alameda County Water District, Antelope Valley-East Kern Water Agency, Castaic Lake Water Agency, Central Coast Water Authority, Coachella Valley Water District, Kern County Water Agency, Metropolitan Water District of Southern California, Mojave Water Agency, Palmdale Water District, San Gorgonio Pass Water Agency, Santa Clara Valley Water District, and Tulare Basin Water Storage District.

G. WHEREAS, the Parties to the Action wish to compromise, resolve, settle, and terminate any and all of the disputes or claims in the Action on terms and conditions set forth in the attached Settlement Agreement and Release dated December 31, 2013;

H. WHEREAS, the City of Napa is a Participating Agency of Napa and has an agreement with Napa for a supply of SWP water;

I. WHEREAS, the Settlement Agreement and Release may affect the amount of SWP water delivered to the City of Napa pursuant to its contract with Napa, and the Settlement Agreement and Release contains limitations on additional water supplies for Napa and the City of Napa; and

J. NOW, THEREFORE, in consideration of the mutual covenants contained herein, and intending to be legally bound hereby, the City of Napa acknowledges and agrees to the following:

AGREEMENT

1. Recitals Incorporated. The recitals set forth above, including all definitions therein, are expressly incorporated as terms of this Agreement.

2. Limitations on Additional Water Supplies and Remedies. The City of Napa agrees to abide by the limitations and waivers set forth in subsection 2.2 of the Settlement Agreement and Release as if it were a party thereto, and acknowledges the default and remedies provisions set forth in section 5 of the Settlement Agreement and Release. Subsection 2.2 and section 5 of the Settlement Agreement and Release provide as follows:

2.2 Limitations on Additional Water Supplies: Except as expressly provided for herein, in consideration of the mutual agreements contained in this settlement agreement, and for the term of the existing SWP Contract and any renewal thereof (including during or as a result of any contract extension negotiations), Napa agrees to the following limitations:

2.2.1 Napa shall not claim any preference or priority under Article 18(a) of the existing SWP Contract.

2.2.2 Napa shall not request or be entitled to receive a new or separate SWP Contract that will increase Napa's existing total maximum Table A amount, whether pursuant to Article 18(c) of its existing SWP Contract or any other legal authority, except as provided in subsection 2.2.5 below.

2.2.3 Napa agrees to the following limitations on water right applications filed with the SWRCB.

a. Prior to January 1, 2032, Napa shall not file a water right application with the SWRCB to meet existing or future demands within Napa's service area.

b. If Napa files a water rights application with the SWRCB, to meet existing or future demands within Napa's service area after January 1, 2032, Napa stipulates that any water right issued on such application will contain the following language:

"No diversion is authorized by this permit when satisfaction of inbasin entitlements requires release of supplemental Project water by the Central Valley Project or the State Water Project.

Inbasin entitlements are defined as all rights to divert water from streams tributary to the Sacramento-San Joaquin Delta or the Delta for use within the respective basins of origin or the Legal Delta, unavoidable natural requirements for riparian habitat and conveyance losses, and flows required by the State Water Resources Control Board for maintenance of water quality and fish and wildlife. Export diversions and Project carriage water are specifically excluded from the definition of inbasin entitlements.

Supplemental Project water is defined as that water imported to the basin by the projects plus water released from Project storage which is in excess of export diversions, Project carriage water, and Project inbasin deliveries.

The SWRCB shall notify permittee of curtailment of diversion under this term after it finds that supplemental Project water has been released or will be released. The Board will advise permittee of the probability of imminent curtailment of diversion as far in advance as practicable based on anticipated requirements for supplemental Project water provided by the Project operators."

2.2.4 Napa agrees that any request to use SWP storage facilities shall be governed by Article 56 of the SWP Contract. Napa agrees that it will not claim a preferential right to request or receive water stored in SWP facilities and will not claim a preferential right to request to contract for or utilize SWP storage facilities based on the Area of Origin or County of Origin laws or any other legal authority.

2.2.5 The prohibition in subsection 2.2.2 and the time limit in subsection 2.2.3(a) shall not apply if a catastrophic event or Act of God causes a substantial failure in one or more of Napa's existing or future water supplies intended to serve existing or future water demands within Napa's service area.

2.2.6 In the event that Napa files a water right application as provided for in subsections 2.2.3 and 2.2.5, or requests a new or separate SWP contract to increase Napa's existing total maximum Table A amount as provided for in subsection 2.2.5, or Napa's SWP Contract is no longer in effect, then:

(a) Napa has not waived any claim of right associated with the Area of Origin or County of Origin laws, and

(b) DWR and Intervenors have not waived any right to challenge or protest any such claims of right.

2.2.7 The following participating agencies of Napa have also agreed to the limitations and waivers set forth in subsection 2.2, and acknowledge the default and remedies provisions set forth in section 5, as evidenced by a separate addendum to the Settlement Agreement ("**Exhibit C**") to be executed by each of them: City of Napa, City of Calistoga, and City of American Canyon.

2.2.8 Nothing herein shall limit or prohibit Napa from acquiring or purchasing SWP Table A amounts from another SWP Contractor. Any SWP Table A amounts acquired from a SOD contractor shall not be entitled to the NOD Allocation.

2.2.9 These limitations on water rights applications do not apply to any water transfers or petitions for changes of already existing water rights that Napa and its participating agencies pursue and undertake. DWR and Intervenors reserve any and all rights they have to protest or challenge any such water transfers or petitions for change.

5. <u>Default and Remedies</u>

5.1 If Napa or any of its participating agencies files an application with the SWRCB prior to 2032 or requests a new or larger SWP Contract, except as allowed by subsection 2.2.5, this is deemed a breach. DWR will hold all benefits for Napa under the Settlement Agreement and Release in abeyance until the breaching party cures the breach by withdrawing the application or contract request.

5.2 If any Party to this Settlement Agreement, or Participating Agency that has adopted provisions of this Settlement through addendum, breaches, the Parties agree that monetary damages alone would be insufficient. Any non-breaching party can request specific performance, including but not limited to injunctive relief, fourteen (14) days after providing notice of the alleged breach to other Parties as provided in section 5.3 below.

5.3 In the event of an alleged breach, the non-breaching Party agrees to give notice of the alleged breach to all other parties to the Agreement and to consult with the Parties for the purpose of attempting in good faith to resolve any disputes prior to the initiation of litigation or court proceedings.

5.4 The use by the Party or the State of any remedy specified herein for the enforcement of the Settlement Agreement is not exclusive and shall not deprive either from using any other remedy provided by law.

5.5 In any action by any of the Parties to enforce or interpret the Settlement Agreement, the prevailing party is entitled to attorney fees and costs, including expert costs.

5.6 If Napa breaches the Settlement Agreement, the limitation provisions in subsection 2.2 will survive as against Napa.

3. Independent Investigation. The City of Napa has made such investigation of the facts pertaining to this Addendum and of all matters pertaining thereto as it deems necessary.

4. Voluntary and Knowing Execution. The City of Napa represents and warrants to each Party to the Action that it has thoroughly read and considered all aspects of this Addendum and the Settlement Agreement and Release, that it understands all provisions of this Addendum and the Settlement Agreement and Release, that it has had the opportunity to consult with counsel, and that it is voluntarily and knowingly entering into this Addendum to the Settlement Agreement and Release without duress or coercion of any kind.

SO AGREED:

CITY OF NAPA

By Jill Techel
JILL TECHEL
Mayor

APPROVED AS TO FORM:

By [signature]
MICHAEL BARRETT
City Attorney

ATTEST:

By Lisa Blackmon **Lisa Blackmon, Deputy City Clerk**
DOROTHY ROBERTS
FOR City Clerk

COUNTERSIGNED:

By Desiree B
DESIREE BRUN
City Auditor

EXHIBIT D – NOTICE TO CONTRACTORS

STATE OF CALIFORNIA • NATURAL RESOURCES AGENCY
• DEPARTMENT OF WATER RESOURCES

NOTICE TO

STATE WATER PROJECT CONTRACTORS

NUMBER: 13-15 **DATE:** DEC 31 2013

SUBJECT: Informational Bulletin on Various Contracts for Project Water

FROM:
DEPUTY DIRECTOR
DEPARTMENT OF WATER RESOURCES

The Department of Water Resources may consider various contractual approaches to provide water to requesting entities. Possible approaches would include entering into a new or amended State Water Project Long-Term Water Supply Contract. In considering future requests for water supply and in developing any new agreements for water supply, DWR generally will apply the following principles:

a. The quantity of water to be provided will be limited to that amount needed to meet the demonstrated needs within the entity's service area and also limited to that amount that the entity could reasonably be expected to be established by an application to appropriate water filed with the SWRCB under the provisions of Water Code sections 11460 through 11463.

b. For entities with existing SWP Contracts, it will not receive a new or amended SWP Contract that would increase its existing total maximum Table A Allocation, if any, unless and until it is fully utilizing its current SWP Contract Table A Allocation within its service area.

c. An entity will pay its proportionate share of all retroactive and prospective costs of conservation facilities and applicable transportation facilities, including the payment of interest thereon.

d. The Contract will be subject to the uniformity requirements applicable to the existing SWP Contracts, such that the terms and conditions of the Contract will be substantially uniform with the basic terms and conditions of existing SWP Contracts, and specifically will be subject to the uniform shortage provisions contained in Article 18(a) of existing SWP Contracts.

THE CITY OF AMERICAN CANYON'S ADDENDUM TO THE SETTLEMENT AGREEMENT AND RELEASE

THIS ADDENDUM TO THE SETTLEMENT AGREEMENT AND RELEASE is approved and entered into by the City of American Canyon, a Participating Agency of the Napa County Flood Control and Water Conservation District ("Plaintiff" or "Napa").

RECITALS

A. WHEREAS, on or about July 17, 2008, Napa and other Plaintiffs filed a civil action against the Department of Water Resources ("DWR") in the Superior Court of California for the County of Sacramento (the "Court"), Case No. 34-2008-00016338 CU-BC-GDS, and on or about March 2, 2009 the Court granted Intervenors'[1] Motion to Intervene in the action (the complaint and the complaint in intervention are collectively referred to as the "Action");

B. WHEREAS, Napa and each of the other Plaintiffs and Intervenors has a contract with DWR for a supply of water from the State Water Project ("SWP") which existing contracts are referred to as the "SWP Contracts" or "Water Supply Contracts";

C. WHEREAS, the Plaintiffs, DWR, and Intervenors (collectively "Parties") claims in the Action relate to disputes over the meaning of the Water Supply Contracts regarding Plaintiffs' claimed rights to water under their Contracts pursuant to Water Code section 11460, *et seq.*, and section 10505, commonly referred to as the "area of origin statutes";

D. WHEREAS, each Party disputes the interpretation of the SWP Contracts advanced by the other Parties, and DWR and Intervenors dispute whether any of the Plaintiffs have established area of origin rights and each Party denies that any other Party is entitled to any relief based on the claims alleged in the Action;

E. WHEREAS, the Parties wish to compromise, resolve, settle, and terminate any and all of the disputes or claims in the Action on terms and conditions set forth herein (the "Settled Disputes and Claims"). The Settled Disputes and Claims include any and all disputes or claims related to whether any Plaintiff is entitled to a preference in water deliveries from the SWP under the terms of the existing SWP Contracts;

F. WHEREAS, the Parties and Participating Agency represent that they understand they are waiving significant legal rights by signing the Settlement Agreement and Release and this Addendum, and each Party in no way admits responsibility for debts, liability, and/or obligations owed to any other Party or third parties, and this Agreement is made in a spirit of compromise for the sole purpose of avoiding the uncertainties and expenses of litigation with respect to the Settled Disputes and Claims;

[1] The Intervenors include the following State Water Project ("SWP") contractors: Alameda County Flood Control and Water Conservation District, Zone 7, Alameda County Water District, Antelope Valley-East Kern Water Agency, Castaic Lake Water Agency, Central Coast Water Authority, Coachella Valley Water District, Kern County Water Agency, Metropolitan Water District of Southern California, Mojave Water Agency, Palmdale Water District, San Gorgonio Pass Water Agency, Santa Clara Valley Water District, and Tulare Basin Water Storage District.

G. WHEREAS, the Parties to the Action wish to compromise, resolve, settle, and terminate any and all of the disputes or claims in the Action on terms and conditions set forth in the attached Settlement Agreement and Release dated December 31, 2013;

H. WHEREAS, the City of American Canyon is a Participating Agency of Napa and has an agreement with Napa for a supply of SWP water;

I. WHEREAS, the Settlement Agreement and Release may affect the amount of SWP water delivered to the City of American Canyon pursuant to its contract with Napa, and the Settlement Agreement and Release contains limitations on additional water supplies for Napa and the City of American Canyon; and

J. NOW, THEREFORE, in consideration of the mutual covenants contained herein, and intending to be legally bound hereby, the City of American Canyon acknowledges and agrees to the following:

AGREEMENT

1. Recitals Incorporated. The recitals set forth above, including all definitions therein, are expressly incorporated as terms of this Agreement.

2. Limitations on Additional Water Supplies and Remedies. The City of American Canyon agrees to abide by the limitations and waivers set forth in subsection 2.2 of the Settlement Agreement and Release as if it were a party thereto, and acknowledges the default and remedies provisions set forth in section 5 of the Settlement Agreement and Release. Subsection 2.2 and section 5 of the Settlement Agreement and Release provide as follows:

2.2 Limitations on Additional Water Supplies: Except as expressly provided for herein, in consideration of the mutual agreements contained in this settlement agreement, and for the term of the existing SWP Contract and any renewal thereof (including during or as a result of any contract extension negotiations), Napa agrees to the following limitations:

2.2.1 Napa shall not claim any preference or priority under Article 18(a) of the existing SWP Contract.

2.2.2 Napa shall not request or be entitled to receive a new or separate SWP Contract that will increase Napa's existing total maximum Table A amount, whether pursuant to Article 18(c) of its existing SWP Contract or any other legal authority, except as provided in subsection 2.2.5 below.

2.2.3 Napa agrees to the following limitations on water right applications filed with the SWRCB.

a. Prior to January 1, 2032, Napa shall not file a water right application with the SWRCB to meet existing or future demands within Napa's service area.

b. If Napa files a water rights application with the SWRCB, to meet existing or future demands within Napa's service area after January 1, 2032, Napa stipulates that any water right issued on such application will contain the following language:

"No diversion is authorized by this permit when satisfaction of inbasin entitlements requires release of supplemental Project water by the Central Valley Project or the State Water Project.

Inbasin entitlements are defined as all rights to divert water from streams tributary to the Sacramento-San Joaquin Delta or the Delta for use within the respective basins of origin or the Legal Delta, unavoidable natural requirements for riparian habitat and conveyance losses, and flows required by the State Water Resources Control Board for maintenance of water quality and fish and wildlife. Export diversions and Project carriage water are specifically excluded from the definition of inbasin entitlements.

Supplemental Project water is defined as that water imported to the basin by the projects plus water released from Project storage which is in excess of export diversions, Project carriage water, and Project inbasin deliveries.

The SWRCB shall notify permittee of curtailment of diversion under this term after it finds that supplemental Project water has been released or will be released. The Board will advise permittee of the probability of imminent curtailment of diversion as far in advance as practicable based on anticipated requirements for supplemental Project water provided by the Project operators."

2.2.4 Napa agrees that any request to use SWP storage facilities shall be governed by Article 56 of the SWP Contract. Napa agrees that it will not claim a preferential right to request or receive water stored in SWP facilities and will not claim a preferential right to request to contract for or utilize SWP storage facilities based on the Area of Origin or County of Origin laws or any other legal authority.

2.2.5 The prohibition in subsection 2.2.2 and the time limit in subsection 2.2.3(a) shall not apply if a catastrophic event or Act of God causes a substantial failure in one or more of Napa's existing or future water supplies intended to serve existing or future water demands within Napa's service area.

2.2.6 In the event that Napa files a water right application as provided for in subsections 2.2.3 and 2.2.5, or requests a new or separate SWP contract to increase Napa's existing total maximum Table A amount as provided for in subsection 2.2.5, or Napa's SWP Contract is no longer in effect, then:

(a) Napa has not waived any claim of right associated with the Area of Origin or County of Origin laws; and

(b) DWR and Intervenors have not waived any right to challenge or protest any such claims of right.

2.2.7 The following participating agencies of Napa have also agreed to the ~~limitations and waivers set forth in subsection 2.2, and acknowledge the default and remedies provisions set forth in section 5, as evidenced by a~~ separate addendum to the Settlement Agreement (**"Exhibit C"**) to be executed by each of them: City of Napa, City of Calistoga, and City of American Canyon.

2.2.8 Nothing herein shall limit or prohibit Napa from acquiring or purchasing SWP Table A amounts from another SWP Contractor. Any SWP Table A amounts acquired from a SOD contractor shall not be entitled to the NOD Allocation.

2.2.9 These limitations on water rights applications do not apply to any water transfers or petitions for changes of already existing water rights that Napa and its participating agencies pursue and undertake. DWR and Intervenors reserve any and all rights they have to protest or challenge any such water transfers or petitions for change.

5. <u>Default and Remedies</u>

5.1 If Napa or any of its participating agencies files an application with the SWRCB prior to 2032 or requests a new or larger SWP Contract, except as allowed by subsection 2.2.5, this is deemed a breach. DWR will hold all benefits for Napa under the Settlement Agreement and Release in abeyance until the breaching party cures the breach by withdrawing the application or contract request.

5.2 If any Party to this Settlement Agreement, or Participating Agency that has adopted provisions of this Settlement through addendum, breaches, the Parties agree that monetary damages alone would be insufficient. Any non-breaching party can request specific performance, including but not limited to injunctive relief, fourteen (14) days after providing notice of the alleged breach to other Parties as provided in section 5.3 below.

5.3 In the event of an alleged breach, the non-breaching Party agrees to give notice of the alleged breach to all other parties to the Agreement and to consult with the Parties for the purpose of attempting in good faith to resolve any disputes prior to the initiation of litigation or court proceedings.

5.4 The use by the Party or the State of any remedy specified herein for the enforcement of the Settlement Agreement is not exclusive and shall not deprive either from using any other remedy provided by law.

5.5 In any action by any of the Parties to enforce or interpret the Settlement Agreement, the prevailing party is entitled to attorney fees and costs, including expert costs.

5.6 If Napa breaches the Settlement Agreement, the limitation provisions in subsection 2.2 will survive as against Napa.

3. Independent Investigation. The City of American Canyon has made such investigation of the facts pertaining to this Addendum and of all matters pertaining thereto as it deems necessary.

4. Voluntary and Knowing Execution. The City of American Canyon represents and warrants to each Party to the Action that it has thoroughly read and considered all aspects of this Addendum and the Settlement Agreement and Release, that it understands all provisions of this Addendum and the Settlement Agreement and Release, that it has had the opportunity to consult with counsel, and that it is voluntarily and knowingly entering into this Addendum to the Settlement Agreement and Release without duress or coercion of any kind.

SO AGREED:

CITY OF AMERICAN CANYON

By Dana Shigley
DANA SHIGLEY
City Manager

APPROVED AS TO FORM:

By William D. Ross
WILLIAM D. ROSS
City Attorney

ATTEST:

By Rebekah Barr
REBEKAH BARR
City Clerk

COUNTERSIGNED:

By Sue Casey
SUE CASEY
Administrative Services Director

ATTACHMENT C

Chico District – Historical and Projected Demand

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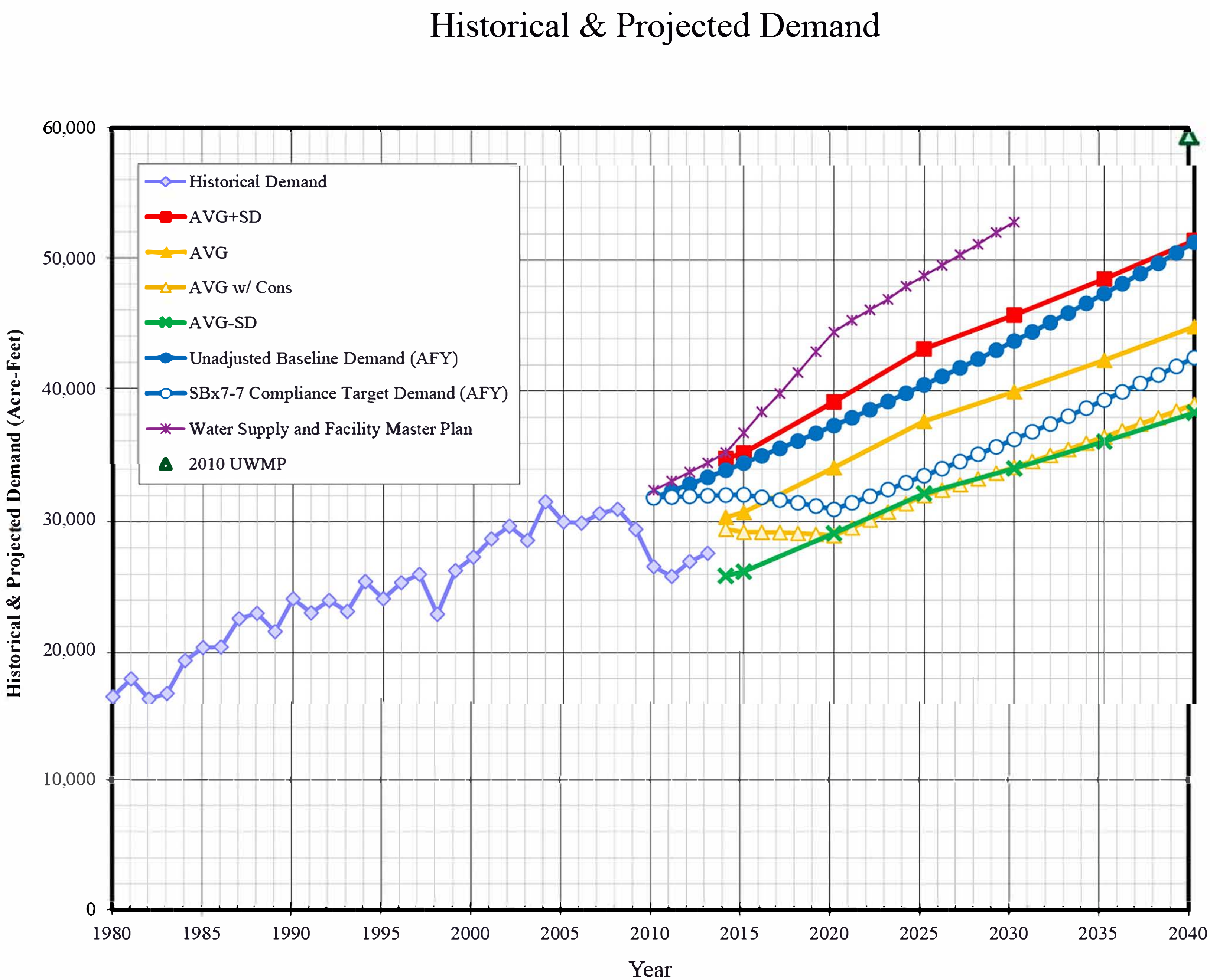
Historical & Projected Demand
Historical Demand
AVG+SD
AVG
AVG w/ Cons
AVG-SD
Unadjusted Baseline Demand (AFY)
SBx7-7 Compliance Target Demand (AFY)
Water Supply and Facility Master Plan
2010 UWMP
Historical & Projected Demand (Acre-Feet)
60,000
50,000
40,000
30,000
20,000
10,000
0
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
Year

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ATTACHMENT D

BCIWFM Simulated Groundwater Hydrographs – Demand Scenarios

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Figure 5-1. BCIWFM Simulated Groundwater Elevations (Node 500)

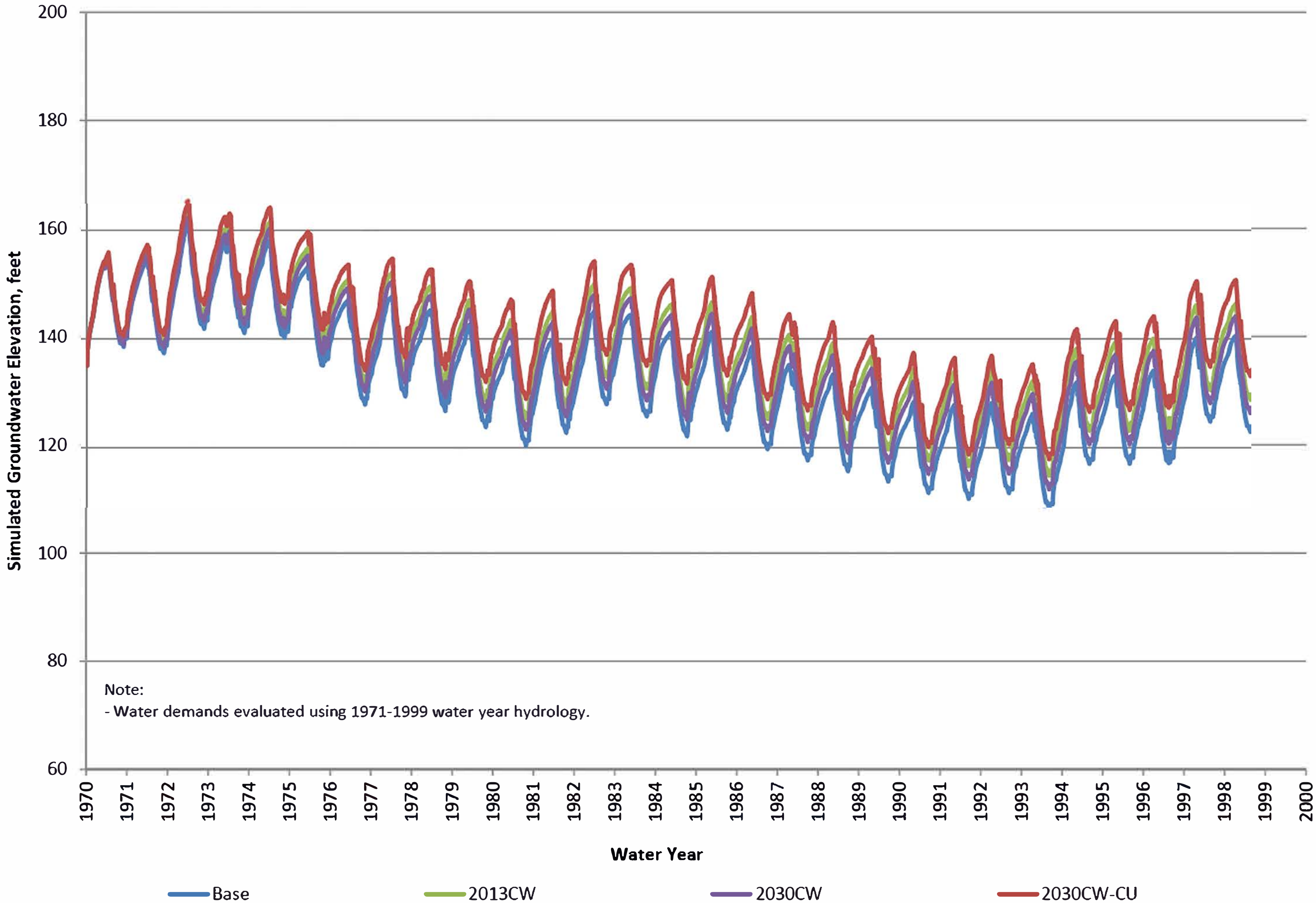
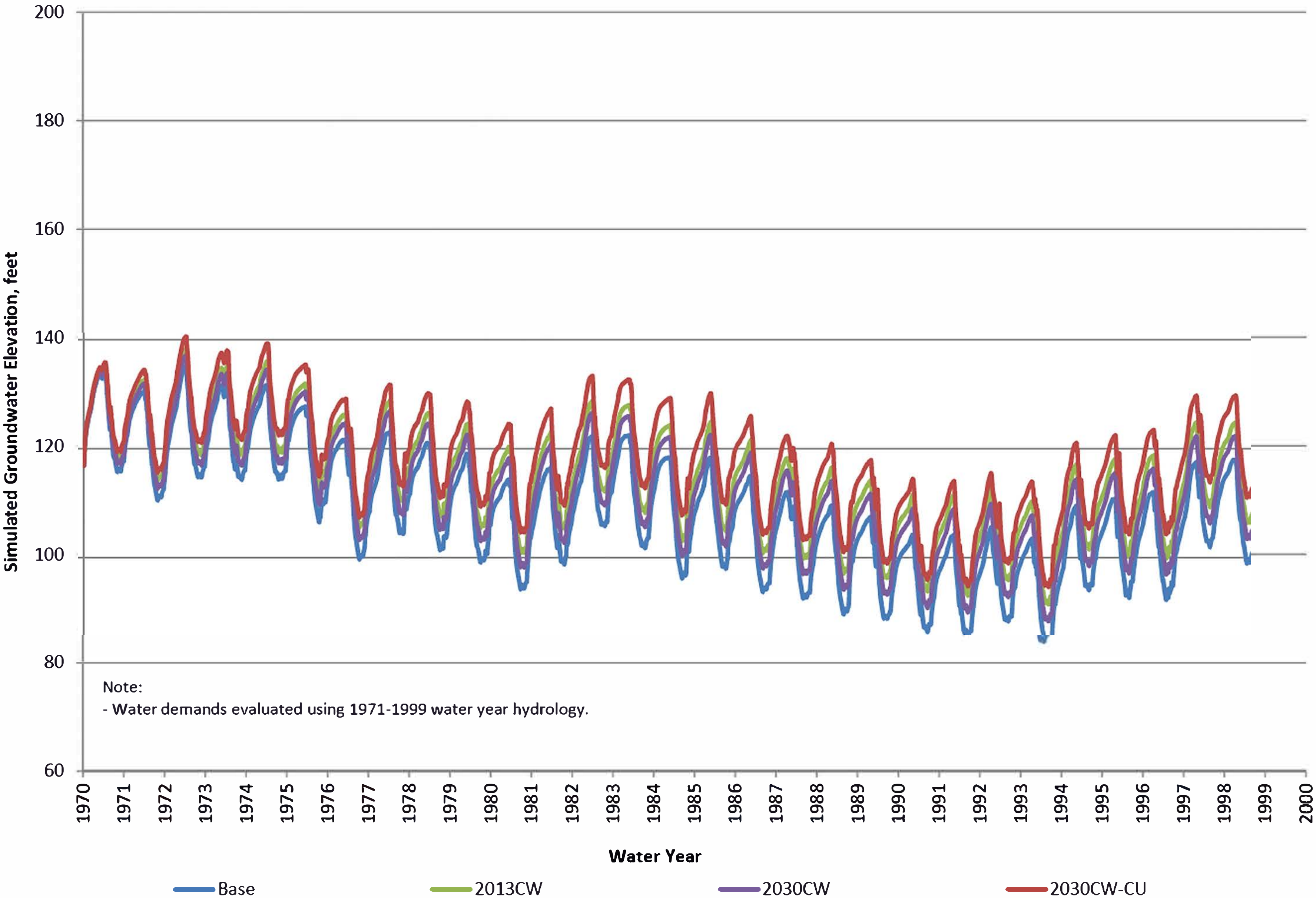


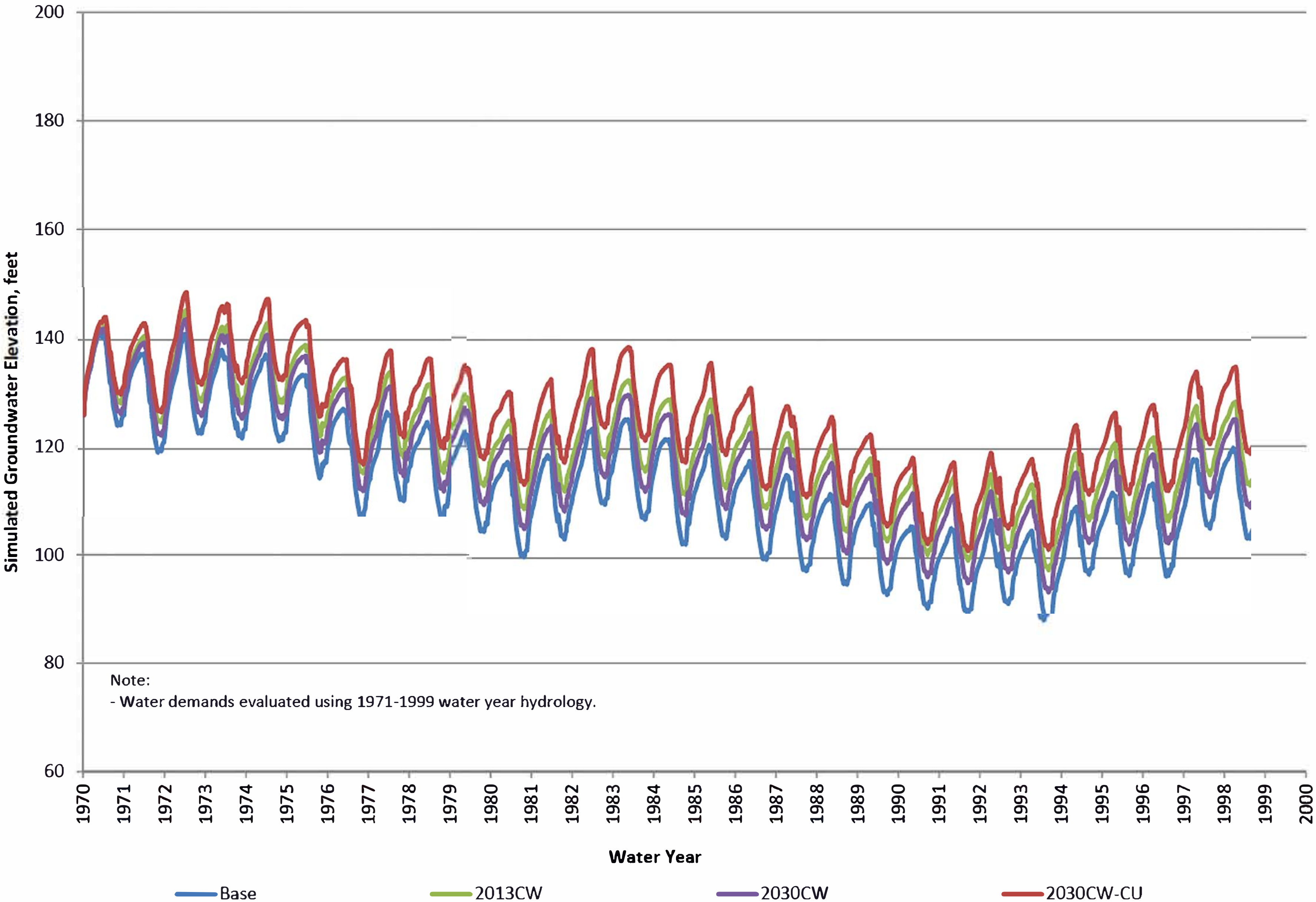
Figure 5-2. BCIWFM Simulated Groundwater Elevations (Node 798)



WEST YOST ASSOCIATES
n\c\436\10-14-19\E\Hydrographs\Figure 5.xlsx
Last Revised: 11-12-14

California Water Service Company
Confidential Chico District
Butte County IWFM Evaluation

Figure 5-3. BCIWFM Simulated Groundwater Elevations (Node 805)



WEST YOST ASSOCIATES
n\c\436\10-14-19\E\Hydrographs\Figure 5.xlsx
Last Revised: 11-12-14

California Water Service Company
Confidential Chico District
Butte County IWFM Evaluation

Figure 5-4. BCIWFM Simulated Groundwater Elevations (Node 850)

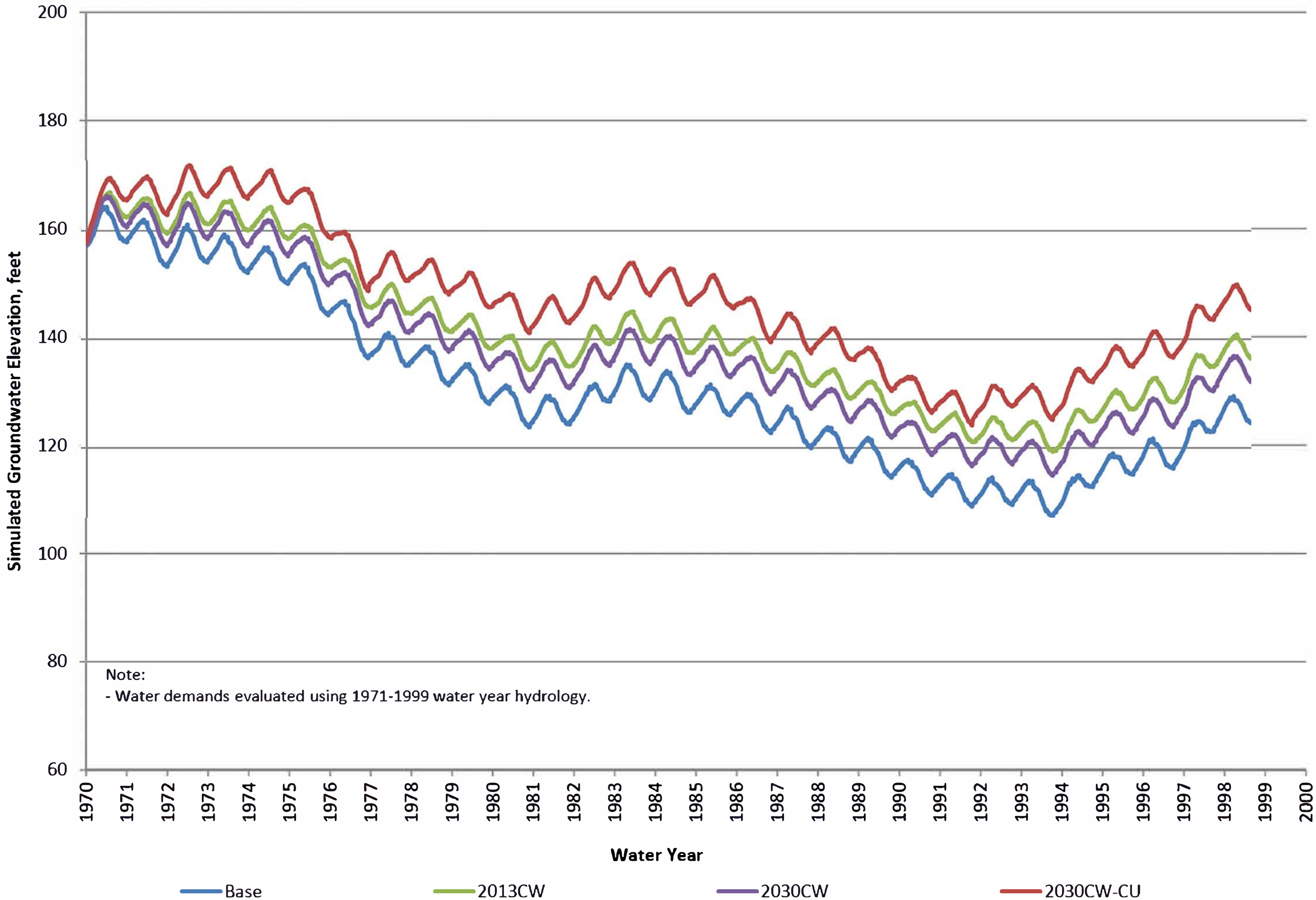


Figure 5-5. BCIWFM Simulated Groundwater Elevations (Node 875)

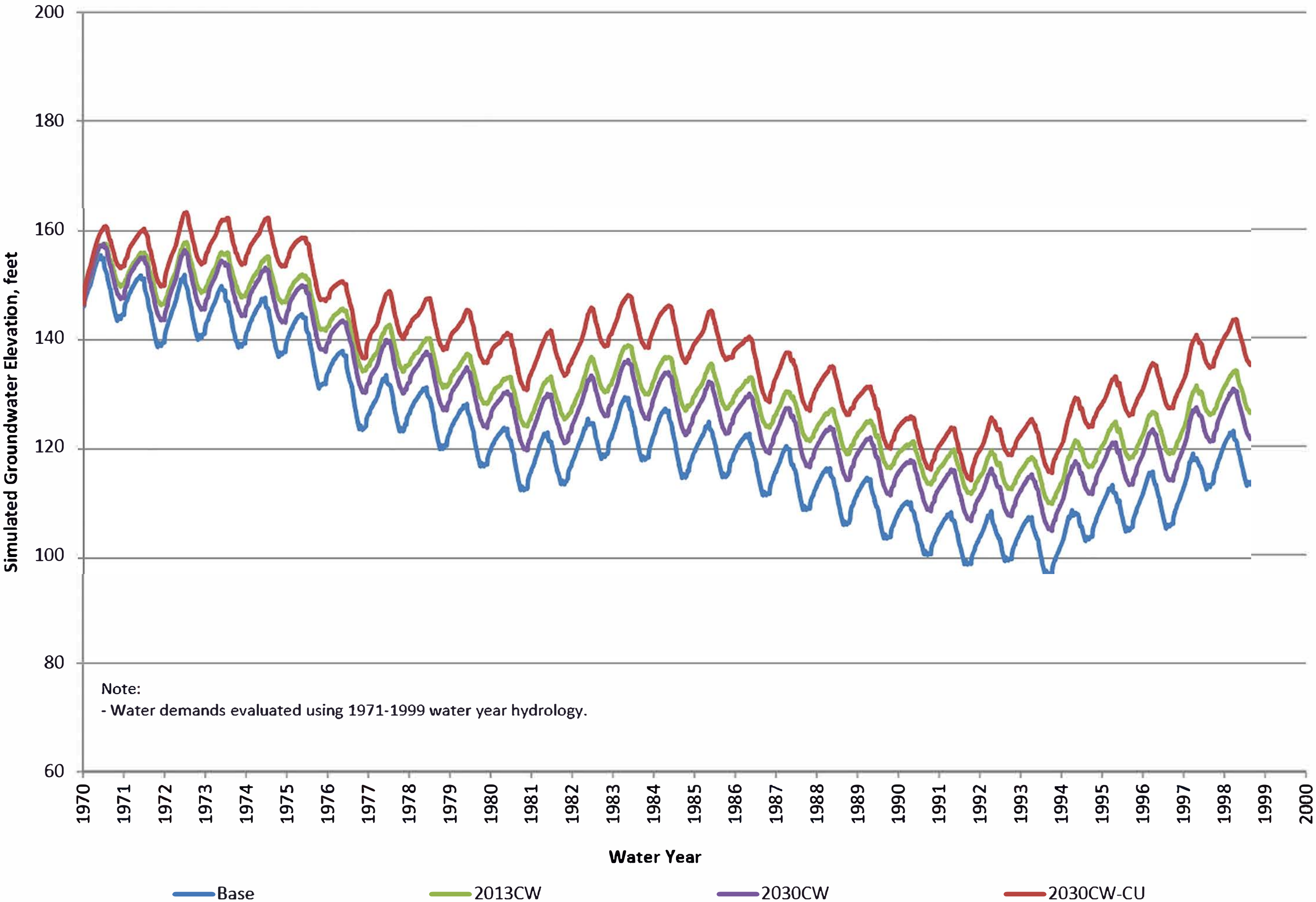


Figure 5-6. BCIWFM Simulated Groundwater Elevations (Node 890)

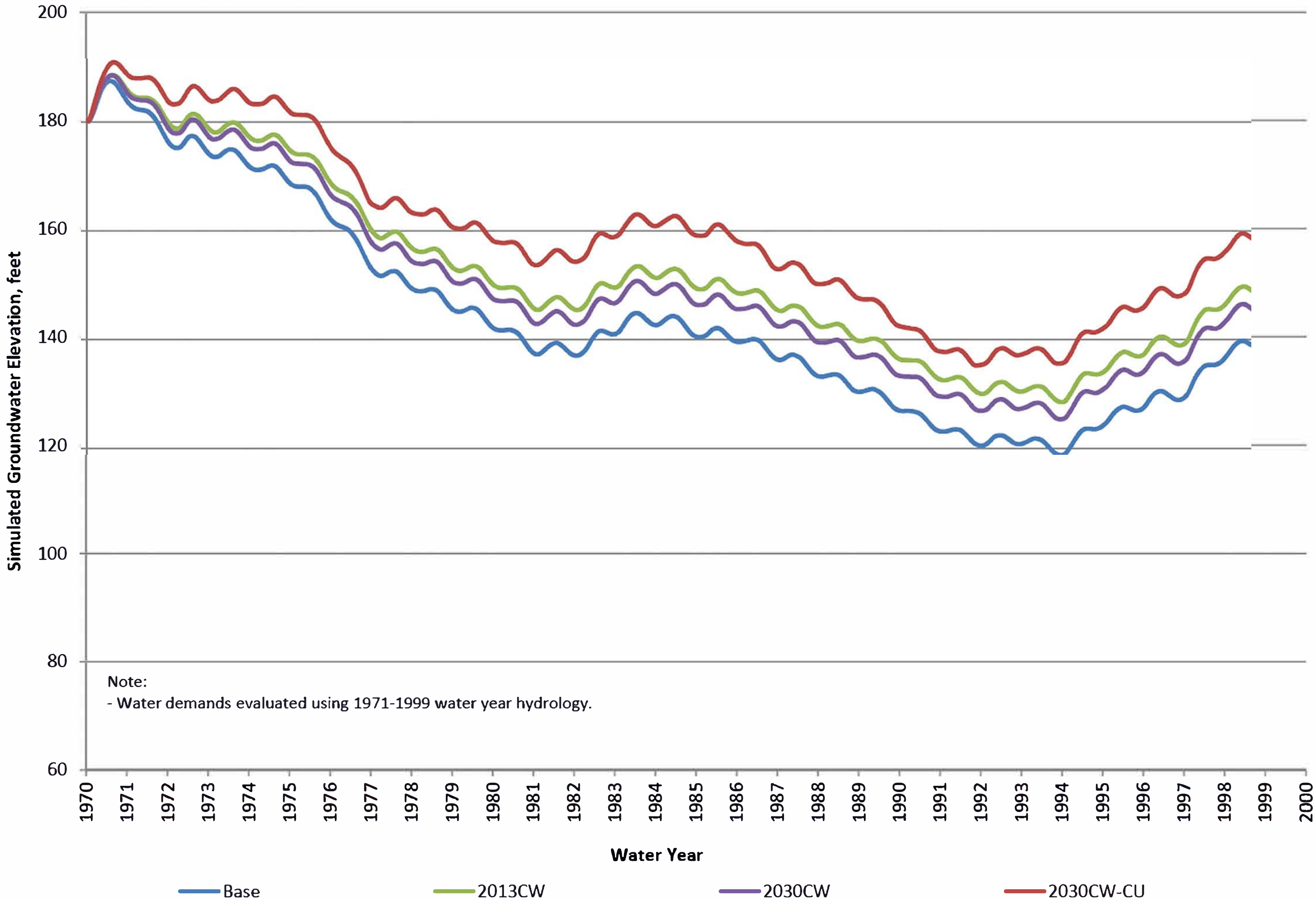
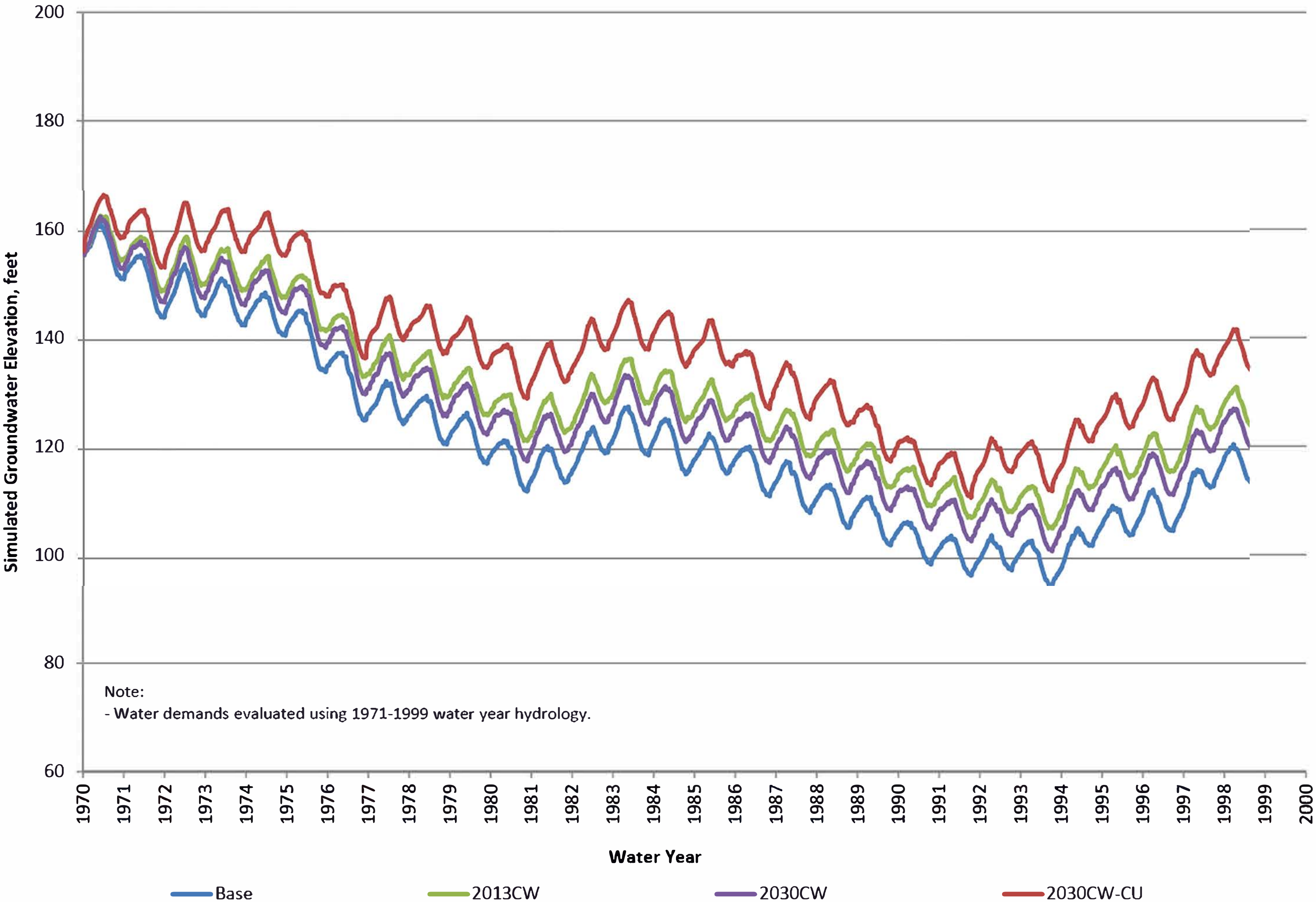


Figure 5-7. BCIWFM Simulated Groundwater Elevations (Node 1086)



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Last Revised: 11-12-14

California Water Service Company
Confidential Chico District
Butte County IWFM Evaluation

Figure 5-8. BCIWFM Simulated Groundwater Elevations (Node 1109)

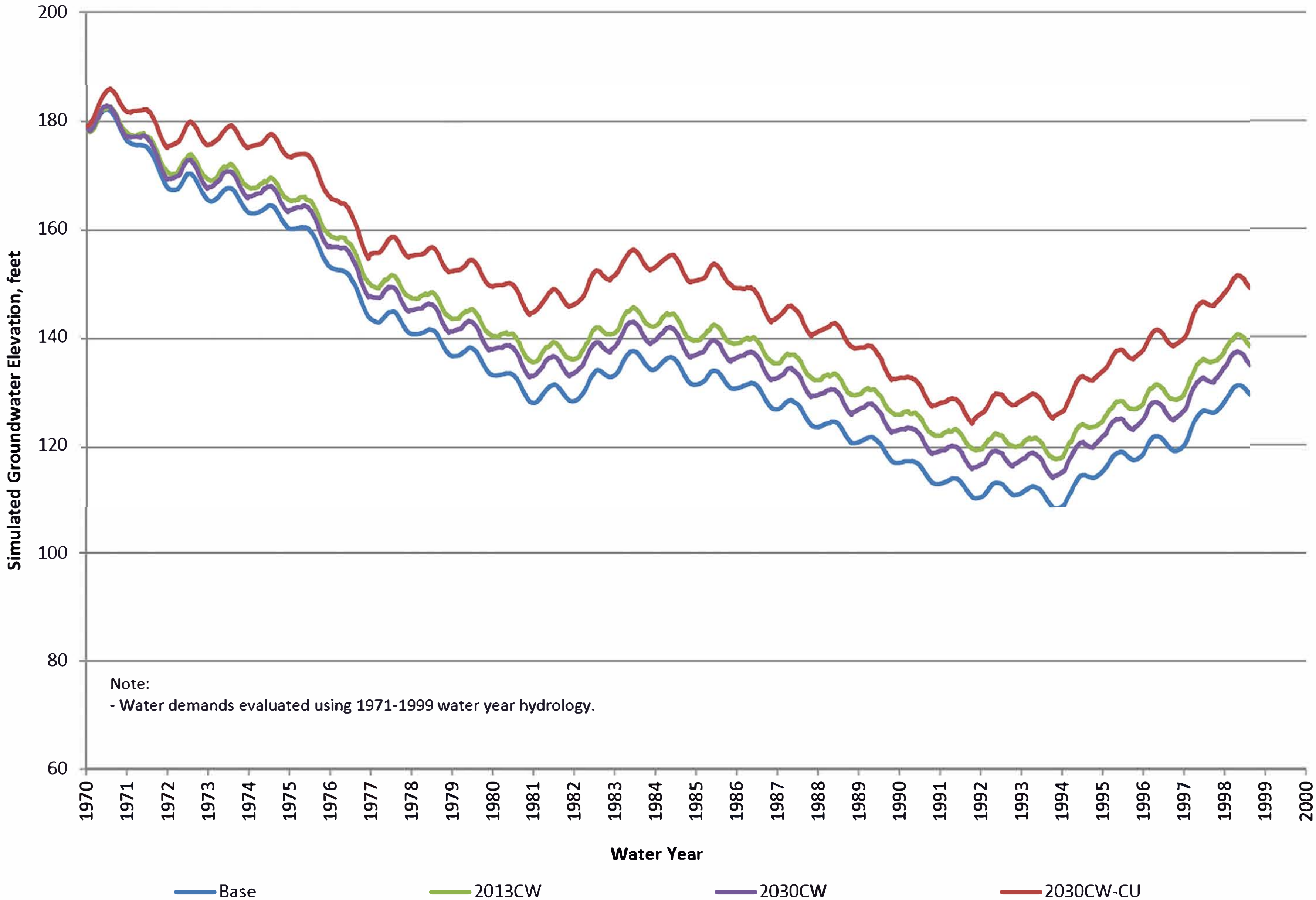
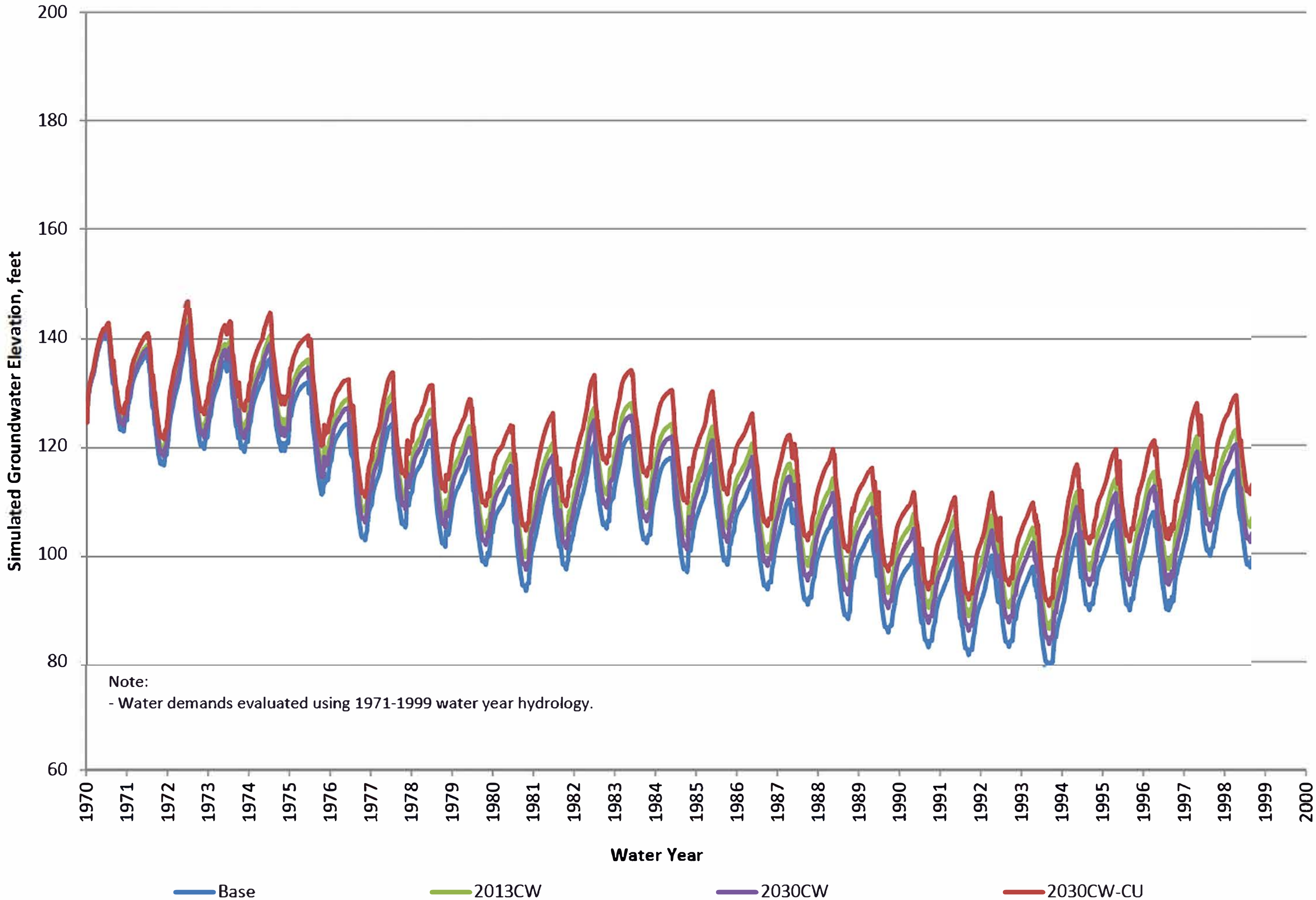


Figure 5-9. BCIWFM Simulated Groundwater Elevations (Node 1178)



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ATTACHMENT E

BCIWFM Simulated Groundwater Hydrographs – Sensitivity Analysis

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Figure 6-1. BCIWFM Simulated Groundwater Elevations (Node 500)

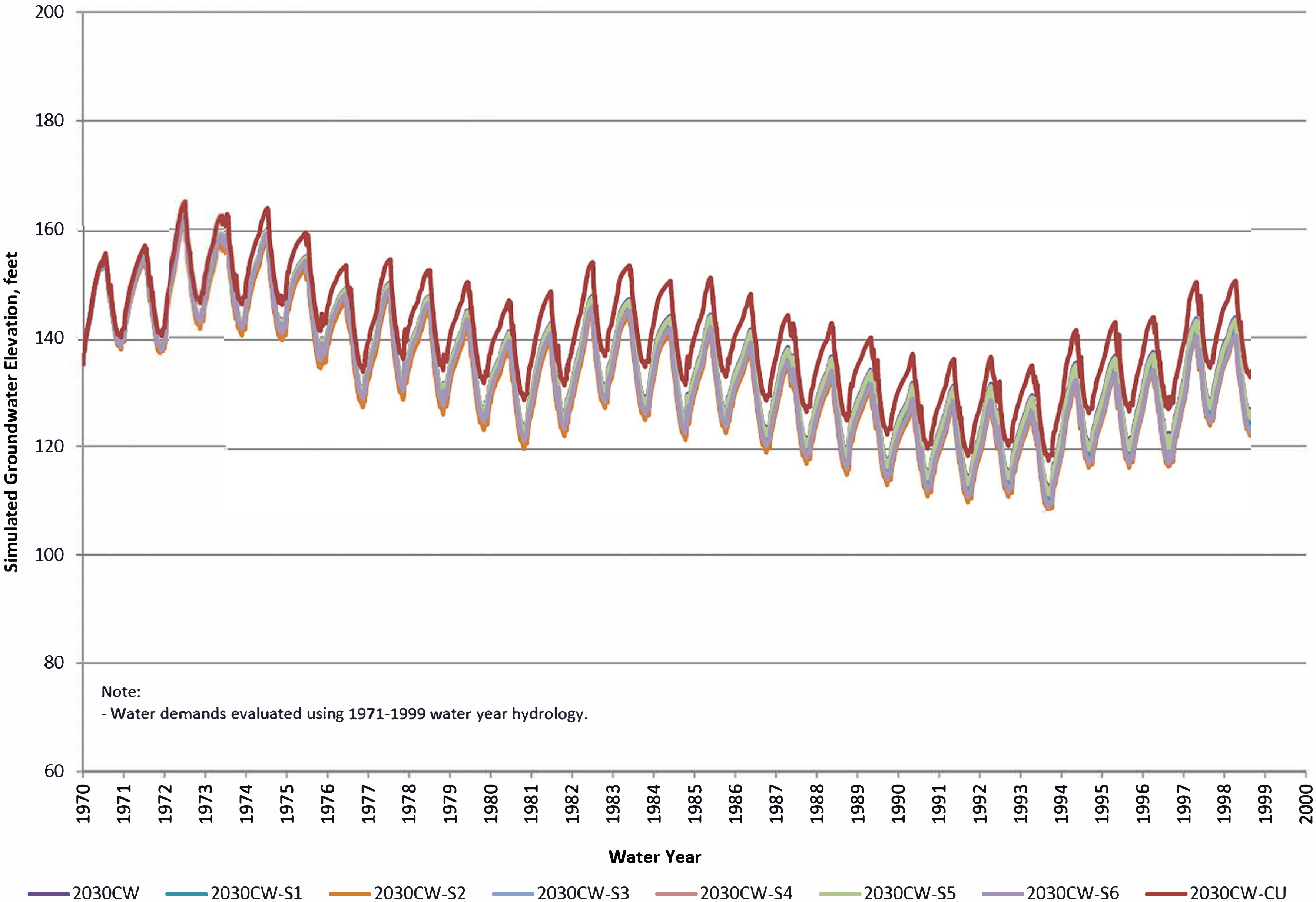
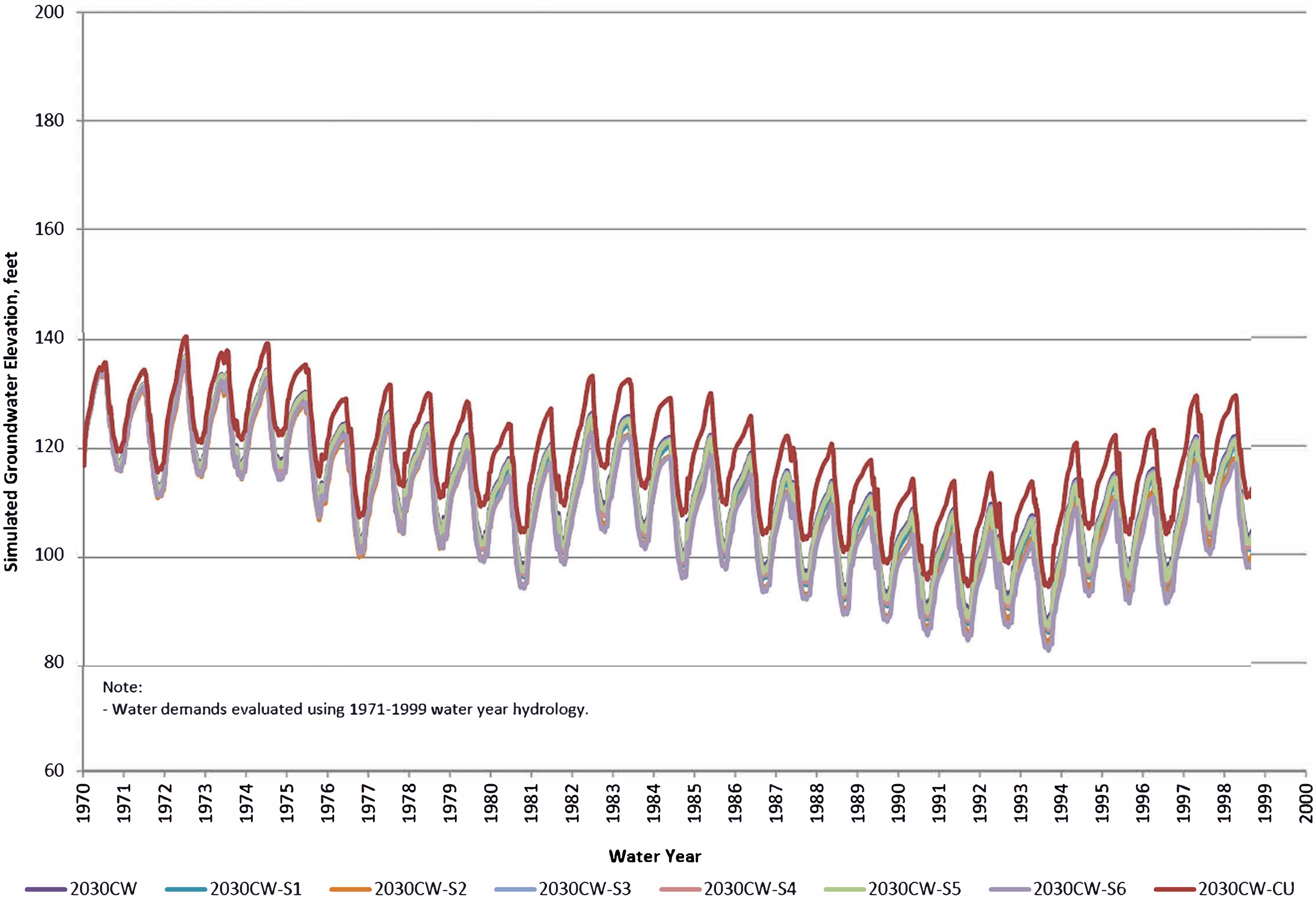


Figure 6-2. BCIWFM Simulated Groundwater Elevations (Node 798)



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n\c\436\10-14-19\E\Hydrographs\Figure 6.xlsx
Last Revised: 11-12-14

California Water Service Company
Confidential Chico District
Butte County IWFM Evaluation

Figure 6-3. BCIWFM Simulated Groundwater Elevations (Node 805)

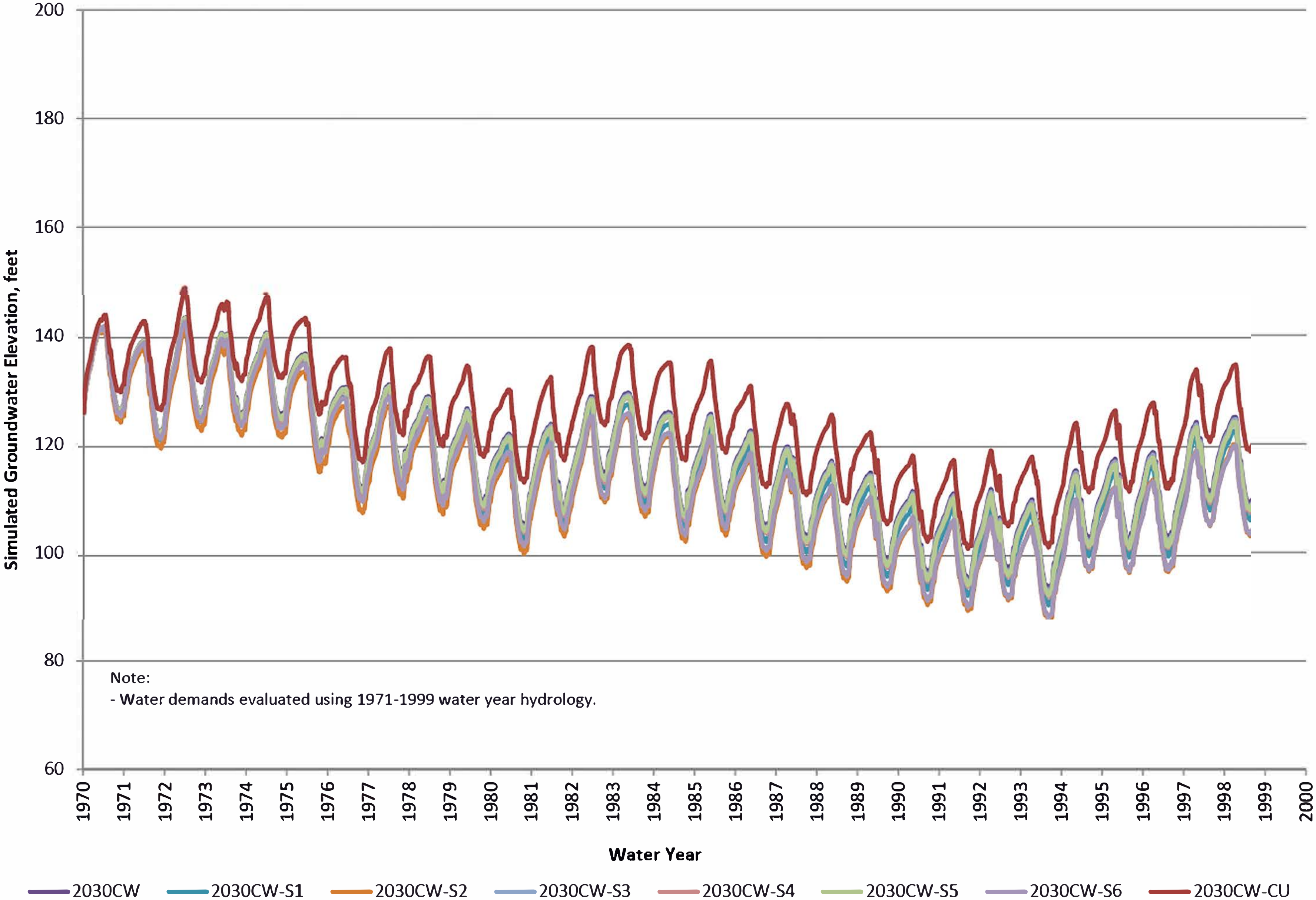
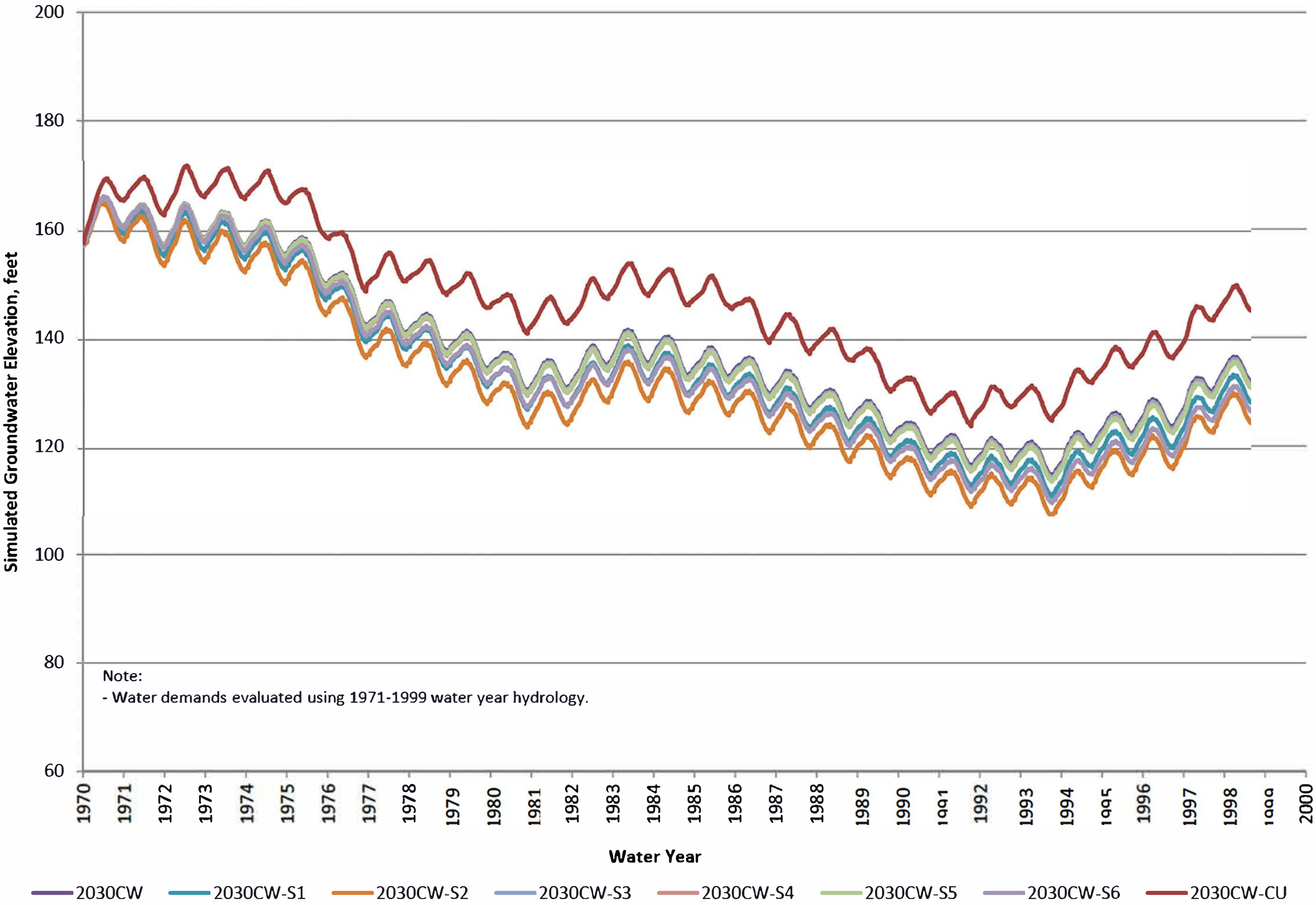


Figure 6-4. BCIWFM Simulated Groundwater Elevations (Node 850)



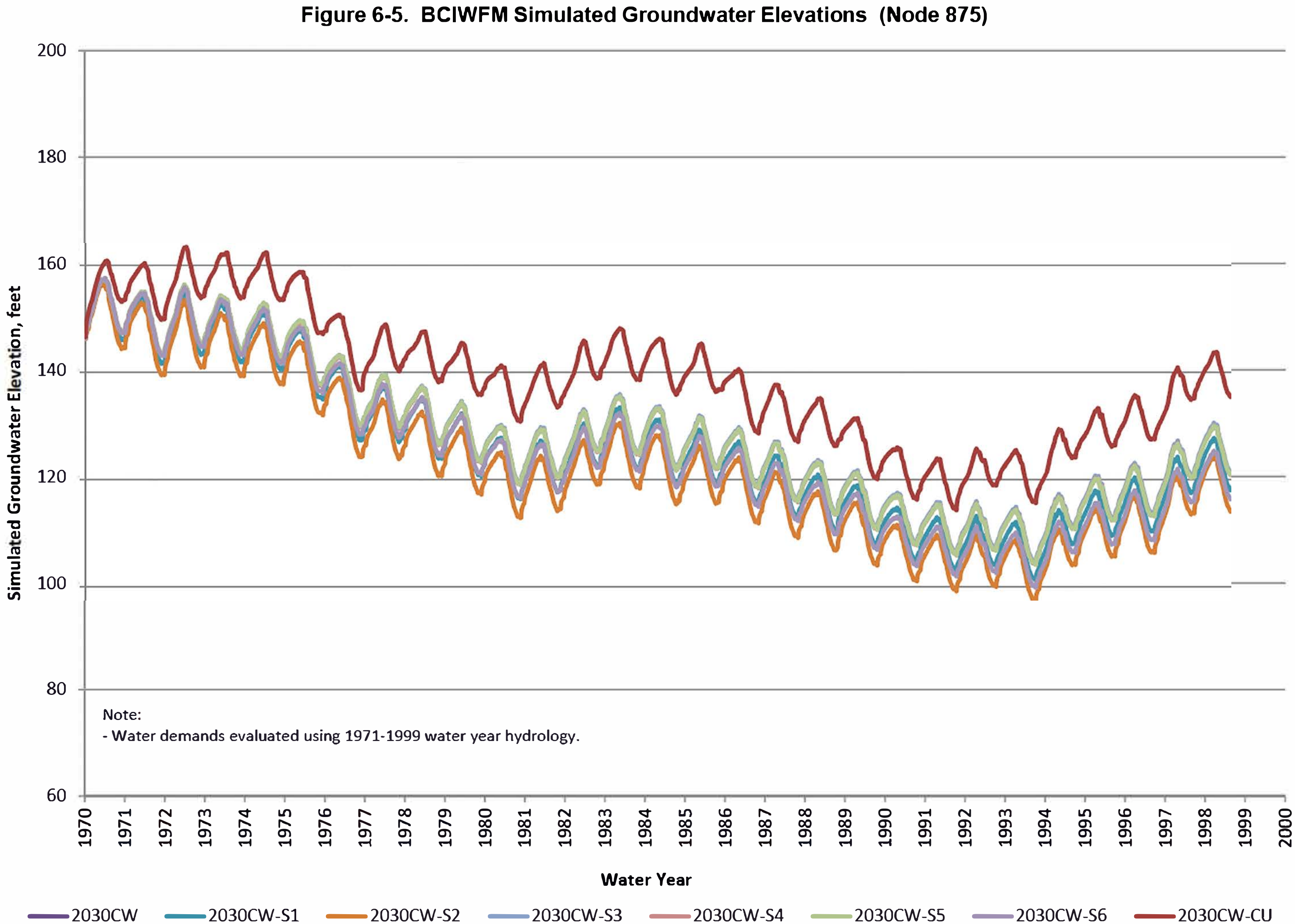


Figure 6-5. BCIWFM Simulated Groundwater Elevations (Node 875)
Simulated Groundwater Elevation, feet
200
180
160
140
120
100
80
60
Note:
- Water demands evaluated using 1971-1999 water year hydrology.
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
Water Year
2030CW
2030CW-S1
2030CW-S2
2030CW-S3
2030CW-S4
2030CW-S5
2030CW-S6
2030CW-CU

Figure 6-6. BCIWFM Simulated Groundwater Elevations (Node 890)

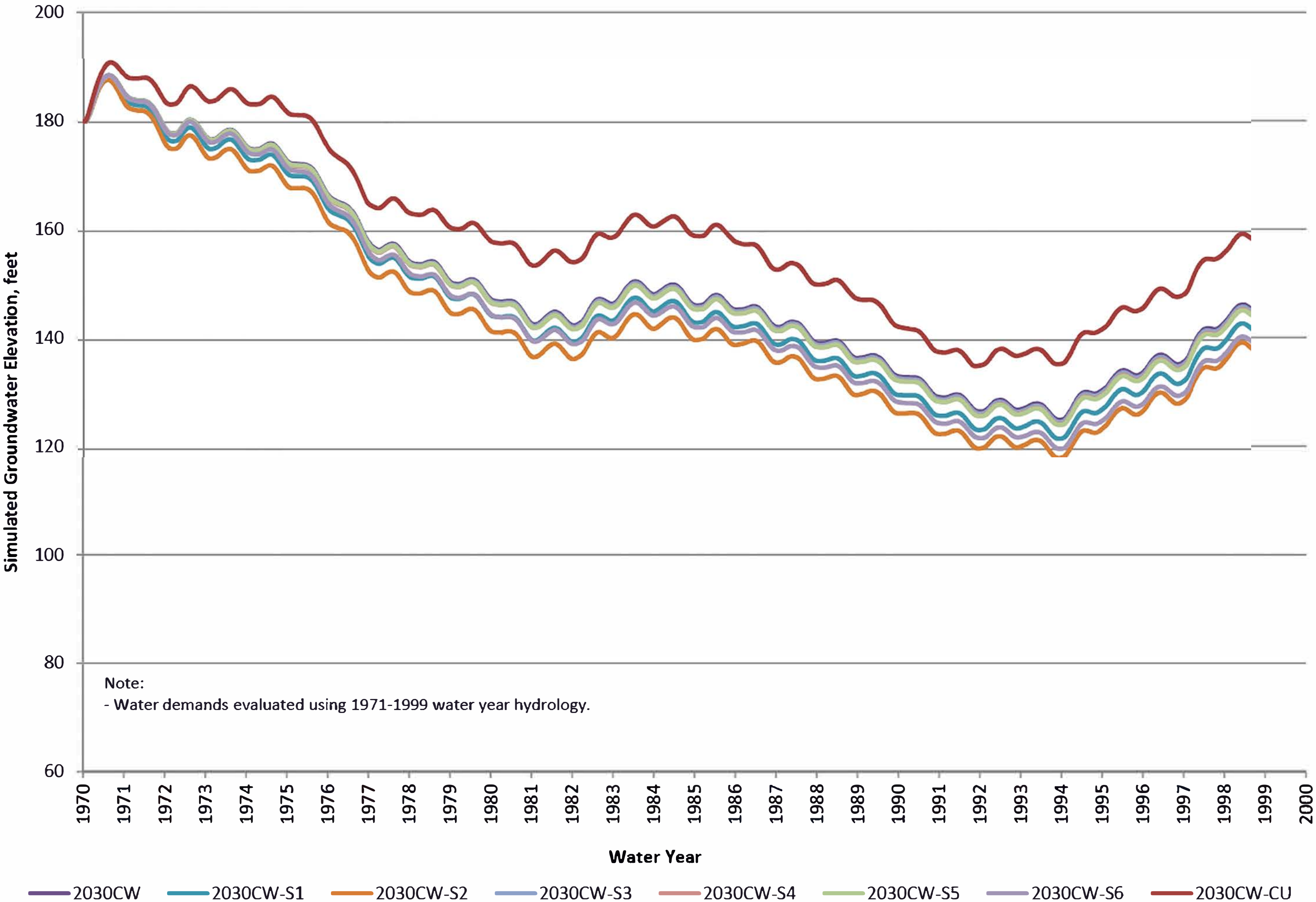


Figure 6-7. BCIWFM Simulated Groundwater Elevations (Node 1086)

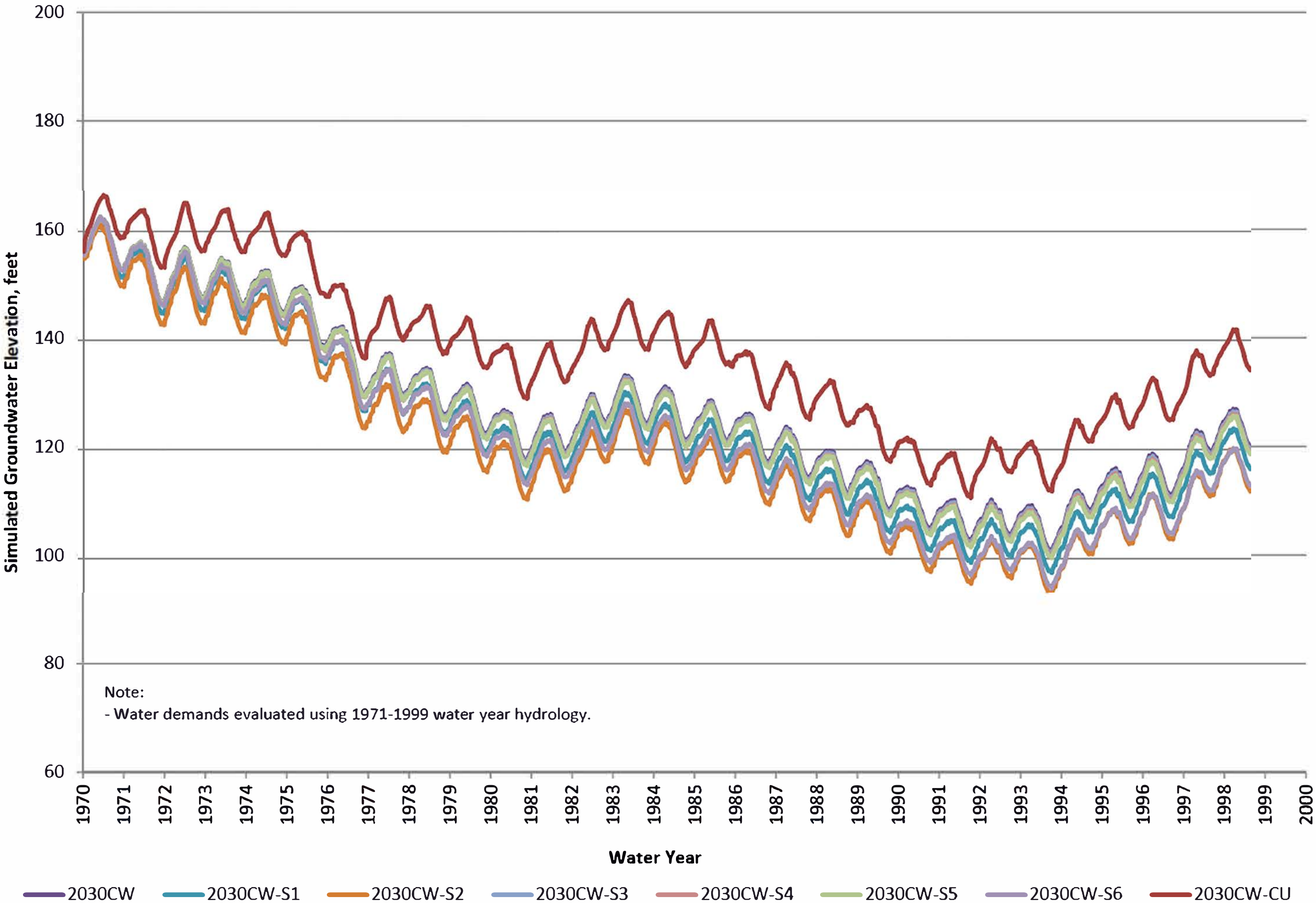


Figure 6-8. BCIWFM Simulated Groundwater Elevations (Node 1109)

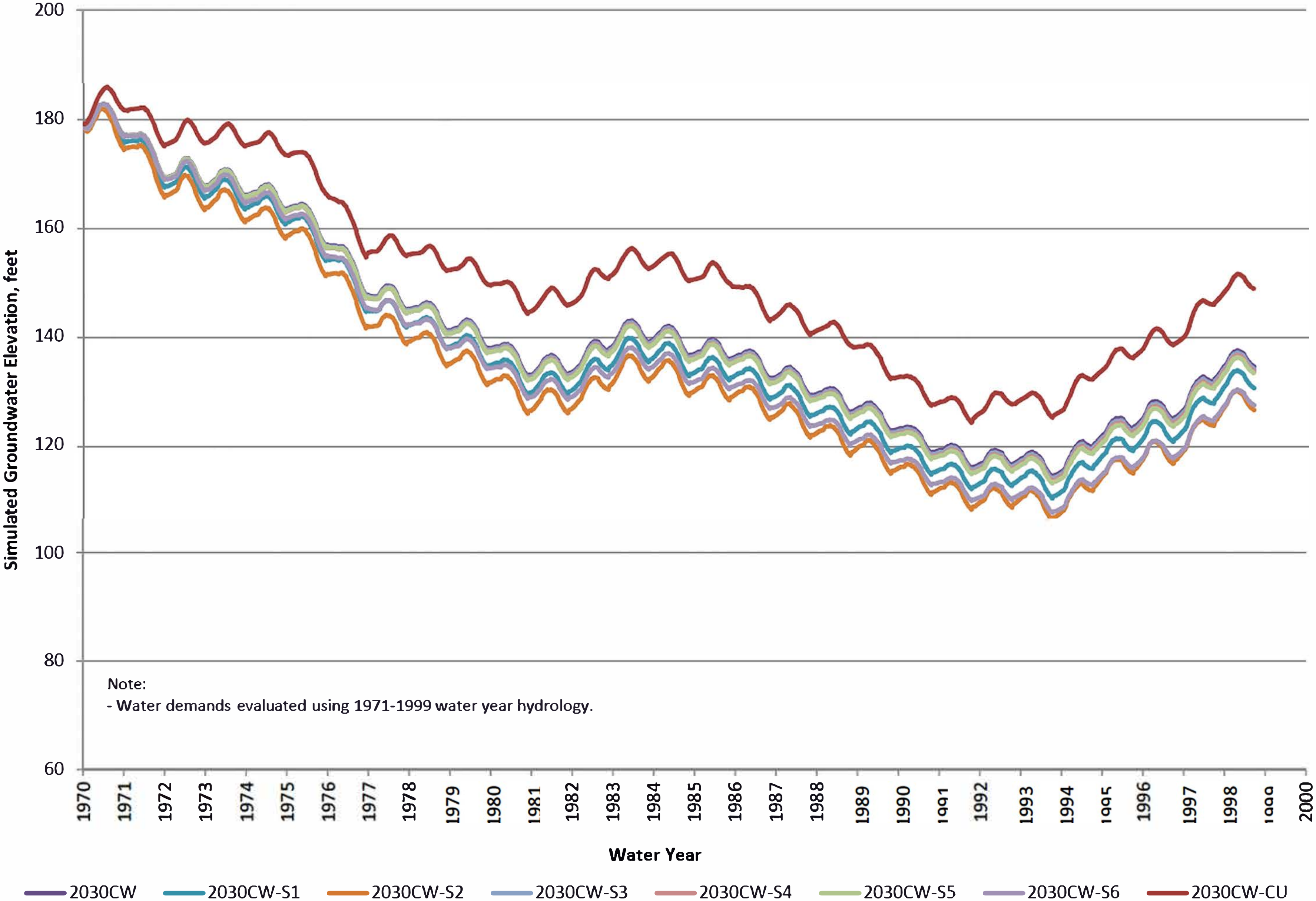
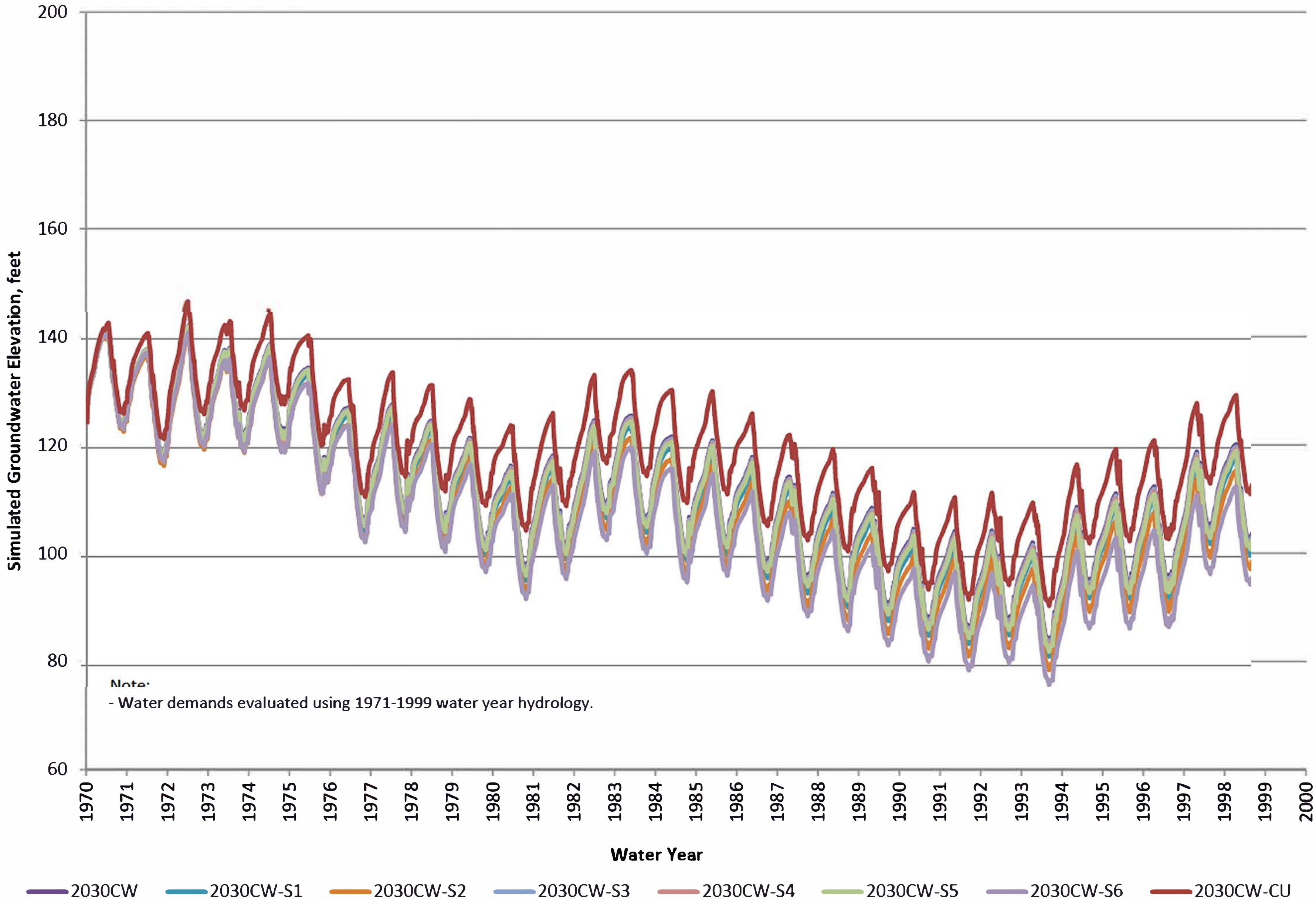


Figure 6-9. BCIWFM Simulated Groundwater Elevations (Node 1178)



WEST YOST ASSOCIATES
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Last Revised: 11-12-14

California Water Service Company
Confidential Chico District
Butte County IWFM Evaluation

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MEMORANDUM

DATE: June 14, 2019

Project No.: 436-12-18-24
SENT VIA: EMAIL

TO: George Barber, Cal Water

FROM: Amy Kwong, PE, RCE #73213

REVIEWED BY: Polly Boissevain, PE, RCE #36164
Charles Duncan, PE, RCE #55498

SUBJECT: Chico District – Surface Water Supply Feasibility Study Summary

In 2011, West Yost Associates (West Yost) began a study to evaluate the feasibility of utilizing Butte County's State Water Project (SWP) long-term contract supply (Table A supply) as a supplemental drinking water supply for California Water Service's (Cal Water) Chico District (District) service area in the City of Chico (City). If feasible, this proposed project could provide for the delivery of surface water supplies to the District to be used conjunctively with the District's existing groundwater supply. Five progressive phases of this study have been completed to date, and West Yost is currently completing Phase 6. The following sections provide a brief summary of the work completed to date.

Phase 1

The Phase 1 evaluation was conducted in early 2012 to evaluate the reliability of Butte County's SWP supply and several potential conveyance alternatives for delivery of this surface water supply to the District. The Phase 1 evaluation recommended a baseload delivery option for surface water supply to the District (i.e., 20,000 acre-feet per year (AFY)) of Table A supply will be evenly split and delivered for treatment over 12 months) because it resulted in the smallest required water treatment plant capacity. Under a baseload delivery option, a new water treatment plant with a minimum treatment capacity of 18 million gallons per day (mgd) is required. The Phase 1 evaluation also analyzed sixteen project alternatives and identified two preferred alternatives for conveyance of surface water supply to the District. The following were the two preferred project alternatives recommended for further evaluation:

- Diversion directly from the Thermalito Forebay with a transmission pipeline along the abandoned Sacramento Northern Railroad alignment to the District; and,
- Diversion from the Sacramento River using radial collector wells (requiring a surface water exchange between U.S. Bureau of Reclamation and the California Department of Water Resources (DWR)) with a transmission pipeline along Highway 32 to the District.

Phase 2

The Phase 2 evaluation further refined the two preferred conveyance alternatives and was conducted in late 2012. The Phase 2 evaluation consisted of the following tasks:

- Identifying anticipated construction, permitting and easement acquisition requirements, and estimating construction, capital, and annual operating costs for the two preferred pipeline conveyance alternatives; and
- Developing a conceptual understanding of the hydrogeologic conditions in the vicinity of the proposed diversion point on the Sacramento River for the radial collector wells, and providing a preliminary hydrogeologic work plan to assess the feasibility, anticipated yield, and proposed design of the radial collector wells.

Cal Water and West Yost staff met on April 24, 2013 to discuss the results of the Phase 2 evaluation. During this meeting, Cal Water staff identified several considerations that could affect the projected water demand estimates and groundwater supply availability assessment documented in the District's 2008 Water Supply and Facilities Master Plan. These considerations included the following:

- The City completed its General Plan update in April 2011;
- Butte County updated the Butte Basin groundwater model in Spring 2008; and
- Recent groundwater level monitoring data suggest that groundwater levels may be declining more rapidly than previously estimated.

Phase 3

The Phase 3 evaluation was conducted in late 2013 and focused on evaluating updated water demands in the District and recent changes in groundwater conditions (quality and levels) to determine if a stronger justification could be made to support the proposed surface water supply project. The Phase 3 evaluation results continued to support a surface water supply project for the District. More specifically, the Phase 3 evaluation recommended that the 2030 baseline scenario in the Butte County Butte Basin groundwater model could be used with updated buildout water demands for the District to simulate and compare the relative changes in groundwater levels and assess how changes in groundwater use in the District, climate change (as it relates to the availability of surface water for irrigation), and expansion of permanent crops (drip irrigation) could potentially affect groundwater levels in the aquifer.

Phase 4

The Phase 4 evaluation was completed in 2015 and evaluated the projected groundwater level changes due to varying levels of municipal water demand for groundwater in the District. This evaluation was performed using the Butte County Integrated Water Flow Model (BCIWFM). The following three water demand scenarios were evaluated in the BCIWFM:

1. Current (2013) water demands met by groundwater;
2. Future (2030) water demands met by groundwater; and

3. Future (2030) water demands met by treated surface water and groundwater.

Evaluation results indicate that the District's groundwater use is a relatively small component of the surrounding regional groundwater use. Therefore, changes in groundwater use within the District do not significantly impact the groundwater levels outside of the localized region of the District. However, results indicate that reduced groundwater use within the District, especially with the introduction of treated surface water supply (conjunctive use), has the ability to improve groundwater levels by approximately 10-15 feet within the localized region of the District. Therefore, results from this evaluation continue to support the study. More specifically, the Phase 4 evaluation recommended that Cal Water evaluate the potential for a regional surface water supply project to garner support and/or funding. Possible partners could include Butte County, Paradise Irrigation District, and the Durham Irrigation District.

Phase 5

The Phase 5 evaluation started with a meeting at Paradise Irrigation District (PID) held on July 6, 2016. Water conservation and reduced water system losses have significantly reduced water demand in the PID system. Combined with the minimal growth expected due to the lack of a sewer conveyance and treatment system, PID indicated that it may have an excess of 8 to 10 mgd of treated water supply during normal years. PID staff had already developed a preliminary pipeline alignment and concept to deliver excess PID treated water supply to the District. Because the source water would be from the West Branch Feather River (Miocene Canal/PG&E), it will need to be evaluated for water rights, timing, and quality. However, in January 2017, Stan Ferraro requested West Yost hold off from contacting PG&E due to ongoing contract and relicensing negotiations.

Phase 6 (current work in progress)

Following the completion of the earlier work performed from Phases 1 through 5, the current implementation of the Sustainable Groundwater Management Act (SGMA) provides a new regulatory overlay and new opportunities for Cal Water to partner with the regional agricultural community to implement a surface water supply project that would reduce impacts to the local groundwater resources, either through direct recharge or in-lieu recharge projects.

Although the original intent of the study was to utilize Butte County's Table A supply, Phase 6 re-evaluates some of the projects previously identified, adds new projects not previously considered, evaluates other sources of surface water supply in addition to the Table A supply, and further develops selected projects and screens them to develop the recommended work plan for Phase 7.

Based on the most recent available data for groundwater levels in the surrounding Chico urban area and the District's groundwater production, an annual groundwater production volume of 18,000 AFY appears to be a reasonable, conservative estimate of sustainable yield for groundwater pumping from the aquifer underlying the District. The District's current projected buildout (2040) demands range from approximately 37,000 AFY to 41,000 AFY. This indicates that the additional supply needed to meet the projected demands above the current baseline groundwater production ranges from 19,000 AFY to 23,000 AFY. Therefore, the recommended supply delivery requirement is approximately 20,000 AFY, consistent with the volume that was originally evaluated in Phase 1. This recommendation should support compliance with SGMA and simultaneously meet the

District's projected future water demands. However, this supply delivery requirement would need to be re-evaluated periodically to determine if the new State mandated conservation requirements would further decrease water demands, thus lowering the supply requirement.

West Yost also held many conference calls and meetings in 2018 to evaluate available water supply. Discussions were held with Butte County, City of Chico, M&T Ranch, Llano Seco, Western Canal Water District, Richvale Irrigation District, Butte Water District, Durham Irrigation District, South Feather Water and Power Agency, and regional agricultural users. There appears to be opportunities for regional partnership and shared project costs; however, multiple water supply sources would need to be combined to provide a year-round supply to the District.

Findings from the Phase 6 evaluation are currently being summarized in a Draft Technical Memorandum for Cal Water staff review.

WEST YOST ASSOCIATES

TECHNICAL MEMORANDUM

DATE:	September 27, 2019	Project No.: 436-12-18-24 SENT VIA: EMAIL
TO:	George Barber, Cal Water	
FROM:	Polly Boissevain, RCE #36164 Amy Kwong, RCE #73213 Vickie Newlin	
REVIEWED BY:	Charles Duncan, RCE #55498 CJD	
SUBJECT:	Surface Water Supply Feasibility Study for Cal Water's Chico District – Phase 6	

REGISTERED PROFESSIONAL ENGINEER
AMY W. KWONG
No. C73213
Exp. 12-31-20
CIVIL
STATE OF CALIFORNIA

BACKGROUND

Following the completion of earlier work phases for the Surface Water Supply Feasibility Study (Study), the current implementation of the Sustainable Groundwater Management Act (SGMA) provides a new regulatory overlay as well as new opportunities for California Water Service (Cal Water) to partner with the agricultural or other community members to implement a surface water supply project that would reduce impacts to the local groundwater resources, either through direct recharge or in-lieu recharge projects.

Butte County (County) overlies the Wyandotte Creek, East Butte, West Butte and the Vina groundwater subbasins.[1] The East Butte, West Butte and Vina Subbasins are all classified as high priority basins, and the Wyandotte Creek is classified as a medium priority basin. Under SGMA, all subbasins require the preparation of a Groundwater Sustainability Plan (GSP) that provides a roadmap to identify methods to bring the groundwater basin into long-term sustainability. The GSP will need to identify feasible projects that could be implemented to achieve groundwater sustainability.

Although the original intent of the Study was to utilize the County's State Water Project Table A contract water, this current phase of the Study (Phase 6) re-evaluates some of the projects previously identified, adds new projects not previously considered, evaluates other sources of surface water supply in addition to the County's Table A water supply, and further develops selected projects and screens them to develop the recommended work plan for the next phase of the Study. The following were the key Phase 6 work tasks:

[1] The County recently modified the subbasin boundaries to (1) consolidate the West Butte and East Butte Subbasins into a new "Butte Subbasin", (2) move the southern boundary of the Vina Subbasin to include the City of Chico and align with the northern boundary of Western Canal Water District, and (3) expand the Wyandotte Creek Subbasin to the west to include the City of Oroville.

- Re-evaluate and update the project water supply delivery requirements based on more recent groundwater level trends, annual groundwater production data, and updated projected water demands for the District
- Review and evaluate source water supply options
- Identify and perform preliminary screening of all potential projects
- Select two to three potential projects and perform additional screening for these alternatives
- Summarize findings and develop next steps

The detailed findings and conclusions from each key task in Phase 6 are presented in the following sections:

- Project Water Supply Delivery Requirement Update
- Source Water Supply Options
- Preliminary Screening of Potential Projects
- Evaluation of Selected Alternatives
- Conclusions and Recommended Next Steps

PROJECT WATER SUPPLY DELIVERY REQUIREMENT UPDATE

During the 2014 to 2017 drought, groundwater use was significantly reduced within the District, and groundwater levels in the surrounding aquifer rebounded due to lower water use. The following sections discuss the high-level evaluation of recent District groundwater production data, available groundwater level data, and current water demand projections to approximate the updated surface water delivery requirements for the Project to meet Cal Water's projected SGMA obligations.

West Yost first evaluated historical groundwater production and readily available groundwater level trends to approximate the annual water usage that should correlate with stable groundwater level trends. This information, along with updated growth projections from the District's 2015 UWMP were then used to estimate the additional water supply that would need to be provided to help maintain stable groundwater level trends. The County currently estimates that the District's groundwater use is approximately 11 percent of the total groundwater pumping that occurs in the Vina Subbasin.[2]

Historical Groundwater Production

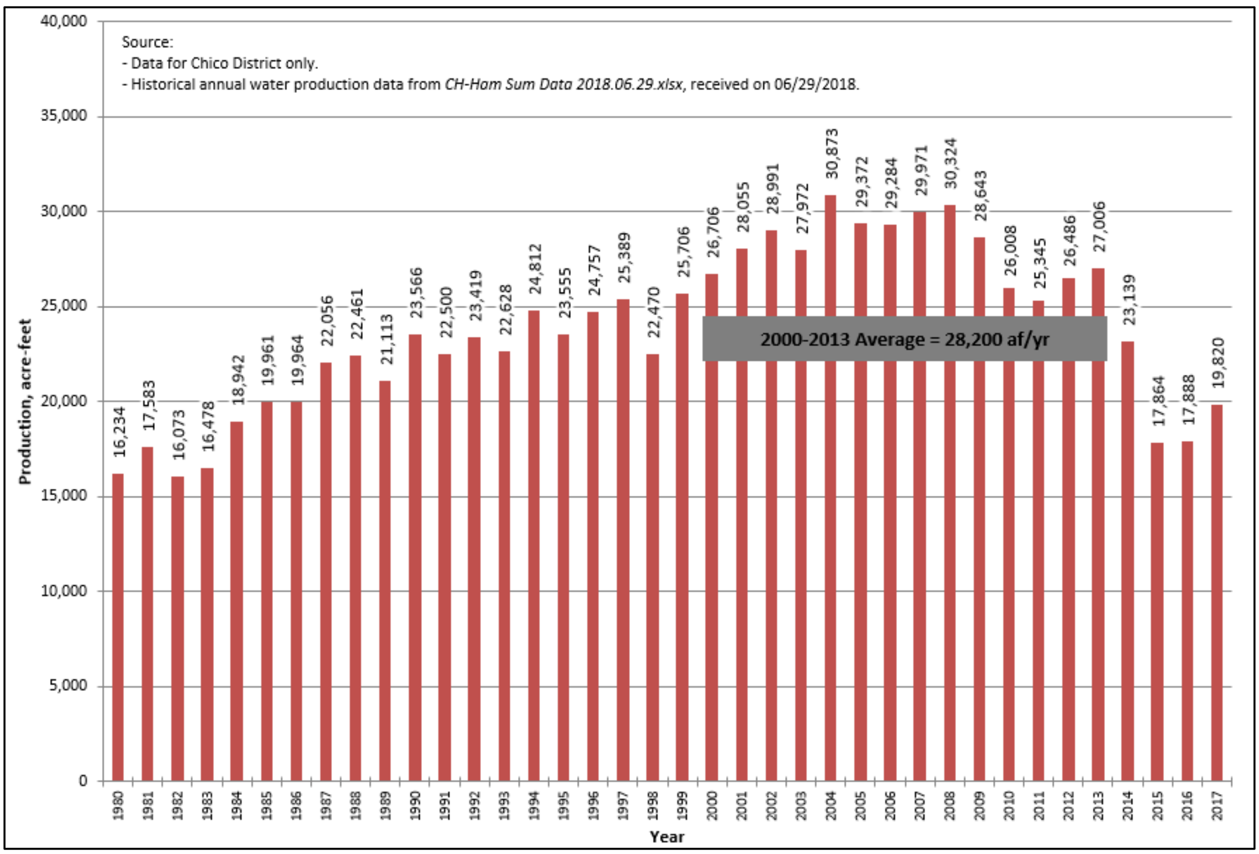
Figure 1 illustrates the historical annual groundwater production for the District based on production data provided by Cal Water. As shown on Figure 1, from 2000 to 2013, the District's average annual groundwater production was approximately 28,200 acre-feet/year (af/yr).

[2] Email correspondence with County staff on May 20, 2019; data based on the County's 2016 Water Inventory and Analysis Report.

However, from 2014 to 2017,[3] the average annual groundwater production was substantially reduced to approximately 19,700 af/yr. From 2015 to 2016, the average annual groundwater production decreased further to levels previously recorded in the early 1980s and was equal to approximately 18,000 af/yr, which is only 66 percent of the District's 2013 annual production (27,000 af/yr).

This significant reduction in annual groundwater production between 2015 and 2016 reflects the impacts from the recent drought. In May 2015, the Drought Emergency Regulation was adopted by the State Water Resources Control Board (State Water Board), which mandated urban retail water suppliers to reduce potable water use between June 2015 and April 2017.

Figure 1. Historical Groundwater Production



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[3] Totals through 2017 include Sierra Nevada Brewery industrial water purchases from Cal Water. A private groundwater well constructed by Sierra Nevada for industrial use was permitted in March 2, 2018.

Recent Groundwater Level Trends

West Yost's Phase 3 TM (West Yost, 2014) presented groundwater level trends for the West Butte and Vina Subbasins through 2013. The historical annual decline in groundwater levels from 1988 through 2013 was 0.43 ft/year for the West Butte Subbasin and 0.44 ft/year for the Vina Subbasin.[4] These rates of groundwater level decline did not specifically indicate overdraft conditions in the aquifer. However, the rate of groundwater decline from 1988 to 2013 was significantly higher than the rate of groundwater decline identified in the District's 2008 Water Supply and Facilities Master Plan (of 0.10 ft/year and 0.09 ft/year for the West Butte and Vina Subbasins, respectively), and was identified during the Phase 3 work effort as indicative that the groundwater levels in the District were declining at a faster rate than previously estimated.

Following completion of the Phase 3 TM, groundwater levels continued to decline in 2014. As noted in the Butte County Department of Water and Resource Conservation's 2014 Groundwater Status Report, the groundwater elevation in the Chico urban area decreased by an average of 5 feet from spring 2013 to spring 2014. The decrease in groundwater elevations from 2013 to 2014 reflects the critically dry conditions in the 2014 water year, and the increased groundwater pumping associated with a dry year.

Recent data from average spring groundwater elevation measurements[5] in the Chico urban area through 2017 indicate that groundwater elevations in the District have stabilized due to a decline in groundwater production mandated by the conservation measures required from the State, as well as wetter than normal hydrologic conditions. Table 1 summarizes the annual precipitation and groundwater production data in conjunction with the spring groundwater elevation estimates for the years 2011 through 2017. As shown on Figure 2, this data indicates that groundwater levels started to rebound in 2016 and 2017 after groundwater production in the District decreased to approximately 18,000 af/yr (in 2015 and 2016). Although a number of factors affect groundwater levels, including urban pumping, agricultural pumping, and rainfall, 18,000 af/yr appears to represent a conservative approximation of a sustainable groundwater pumping rate.

Information from the Butte County Water and Resource Conservation's December 2015 "WaterSolutions" newsletter confirms that the Chico urban area experienced an average of 2.4 feet increase in groundwater levels from 2014 to 2015. This increase in groundwater levels is attributed to the significant reductions in groundwater usage as well as altered outdoor irrigation practices encouraged by various incentive programs made available by the State and Cal Water. The December 2015 "WaterSolutions" newsletter is included for reference as Attachment B.

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[4] The groundwater levels were averaged across 21 wells in the West Butte Subbasin and 36 wells in the Vina Subbasin.

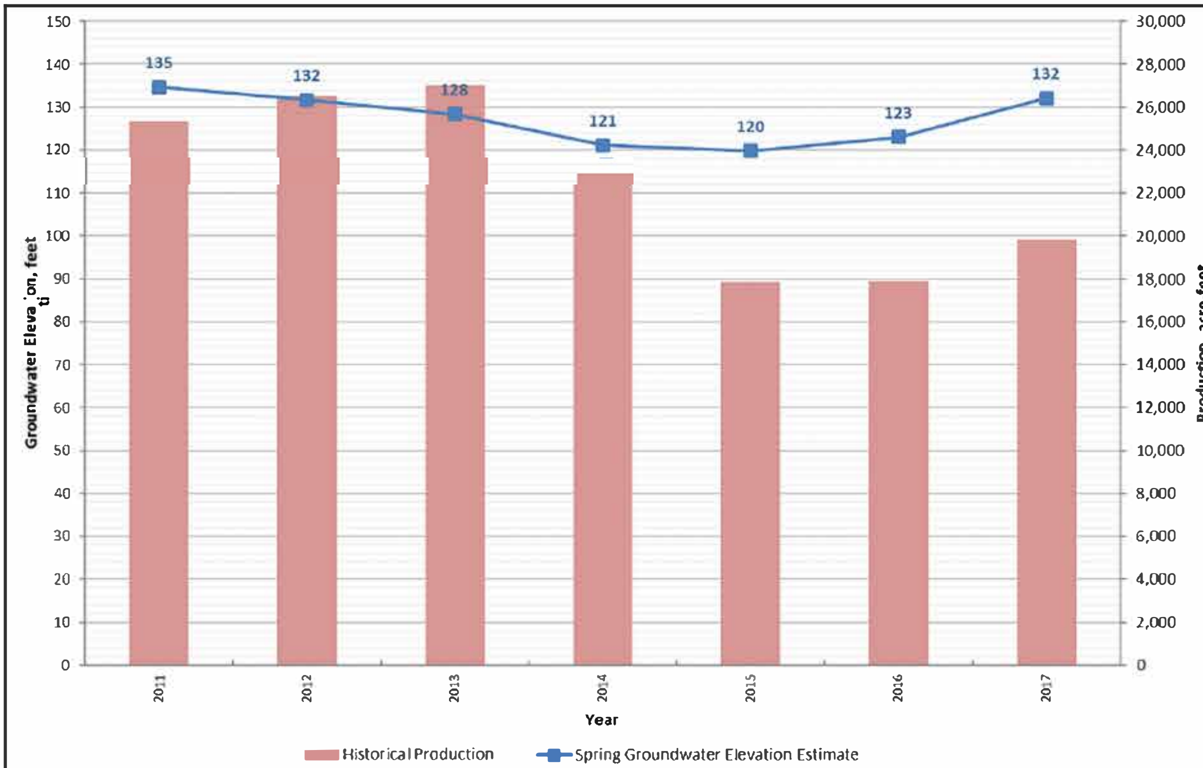
[5] Source: https://gis.water.ca.gov/app/gicima/#bookmark_GroundwaterElevation, State Well Numbers 22N01E35E001M (Site Code 397182N1218432W001) and 22N02E30C002M (Site Code 397270N1218841W001). Refer to Attachment A for locations.

Table 1. Groundwater Elevation Changes

Year	Production[a], af/yr	Change in Production (Compared to Base Year 2011), %	Spring Groundwater Elevation Estimate[b,c,d], ft	Annual Change in Groundwater Elevation, %	Total Precipitation[e,f], inches
2011	25,345	-	134.7	-	18.5
2012	26,486	5%	131.7	-2%	21.6
2013	27,006	7%	128.4	-2%	10.1
2014	23,139	-9%	121.1	-6%	21.7
2015	17,864	-30%	119.8	-1%	10.6
2016	17,888	-29%	123.0	3%	28.0
2017	19,820	-22%	132.1	7%	25.0

(a) Water use in 2015 and 2016 was impacted by the State mandated conservation due to a declared drought emergency.
(b) Information taken from the Groundwater Information Center Interactive Map Application (GICIMA) on DWR's website: https://gis.water.ca.gov/app/gicima/#bookmark_GroundwaterElevation.
(c) Wells #22N01E35E001M and #22N02E30C002M were selected for this evaluation because data from these wells were available consistently from 2011 to 2017.
(d) Attachment A includes maps of GICIMA spring groundwater levels near Chico from 2011 to 2017.
(e) Rainfall data taken from California Irrigation Management Information System (CIMIS) Station 12, located in Durham.
(f) Historical average precipitation at Station 12 from 1983 to 2017 is 22.7 inches per year.

Figure 2. Local Groundwater Levels (2011-2017)



Notes:
- Refer to Table 1 and Figure 1 for data sources.

Updated Water Demand Projections

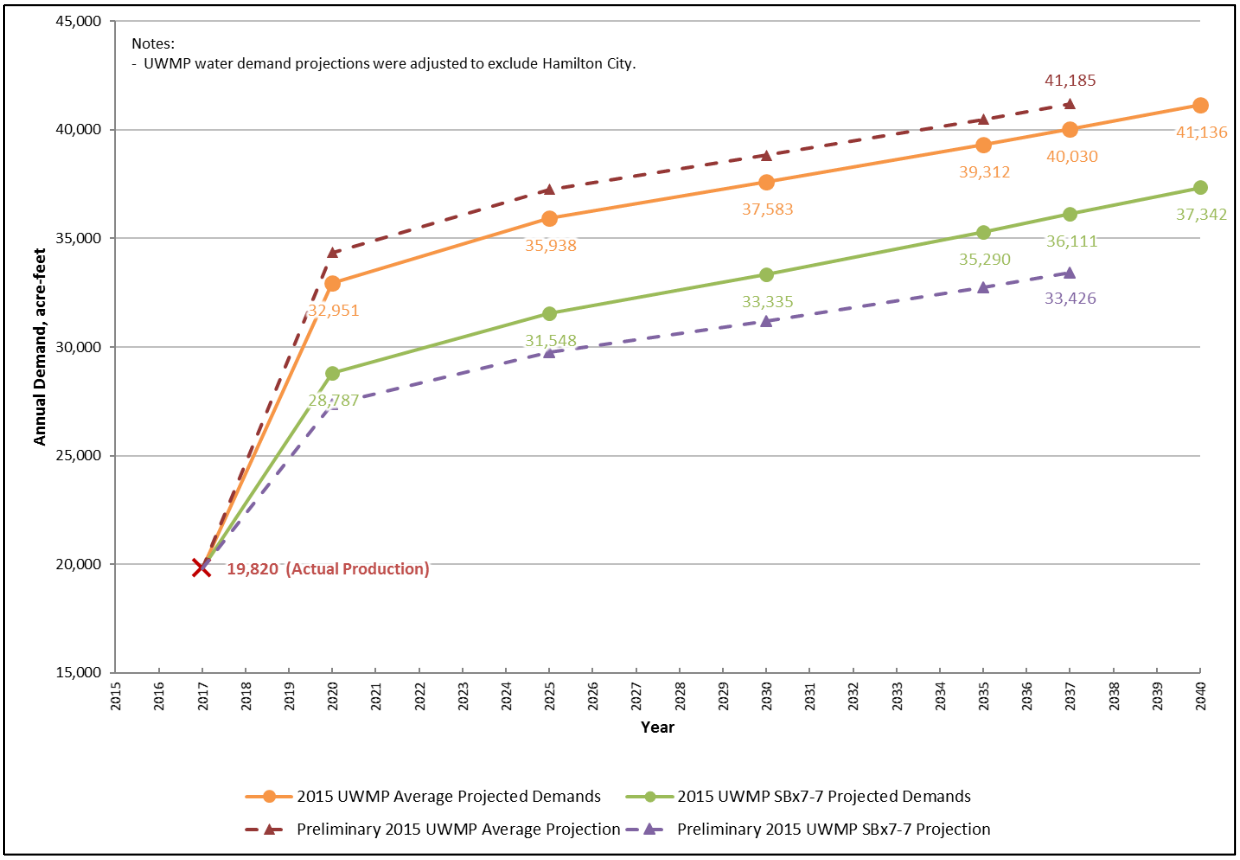
Figure 3 illustrates the most recent water demand projections for the District from the adopted 2015 UWMP. These water demand projections are based on historical water use that was adjusted for future expected water savings from plumbing codes and District conservation programs. The 2015 UWMP average projected demands (solid orange line on Figure 3) are based on unrestricted demands under normal weather conditions. The 2015 UWMP SBx7-7 projected demands (solid green line on Figure 3) factor in future water conservation programs to comply with SBx7-7. Based on the updated 2015 UWMP estimates prepared by Cal Water staff, projected water use for the District in 2040 is estimated to be approximately 41,000 af/yr based on a continuation of historical use, and approximately 37,000 af/yr when factoring in future water conservation programs to comply with SBx7-7.

These projections are slightly different than the preliminary 2015 UWMP projections presented previously in the Phase 3 TM. The Phase 3 TM indicated that a range of 33,000 af/yr to 41,000 af/yr is appropriate for the District's buildout water demand projection. The preliminary UWMP SBx7-7 projection (purple dashed line on Figure 3) was based on lower population projections and has been updated in the 2015 UWMP to reflect more accurate and higher population growth projections. The preliminary UWMP average projection (red dashed line in Figure 3) is very similar to the updated 2015 UWMP average projection once the buildout year (previously assumed to be 2037) is projected to 2040.

Even with the differences between the preliminary and updated 2015 UWMP assumptions, the demand projections varied by only 3,000 af/yr between the preliminary and updated results. Therefore, buildout water demands in the District are currently projected to be between 37,000 and 41,000 af/yr. It should be noted that these demand projections do not reflect the recent 2018 legislation[6] for additional water conservation and drought planning that will likely increase conservation requirements for urban water users. Another consideration that should be made includes accounting for residents from the Town of Paradise who may have permanently relocated to the City of Chico due to the Camp Fire. Therefore, water demand projections should be re-evaluated periodically to determine if the new State mandated conservation requirements or the permanent influx of residents from the Town of Paradise would impact the District's water demands. In addition, Cal Water is currently in the process of finalizing updated water demand projections for the District. It should be noted that if the Project only considers future water supply needs as opposed to the Project providing a supplemental supply for conjunctive use and water supply reliability objectives then any significant changes in the projected water demand for the District could also impact the size of the Project needed (i.e., the recommended supply delivery requirement).

[6] Senate Bill 606 and Assembly Bill 1668 were signed into law on May 31, 2018. The legislation set a standard of 55 gallons/person/day for residential indoor use by 2025, which will then decrease to 50 gallons/person/day by 2030. Commercial, industrial, and outdoor residential water use efficiency standards will be established by June 30, 2022.

Figure 3. Updated Water Demand Projections

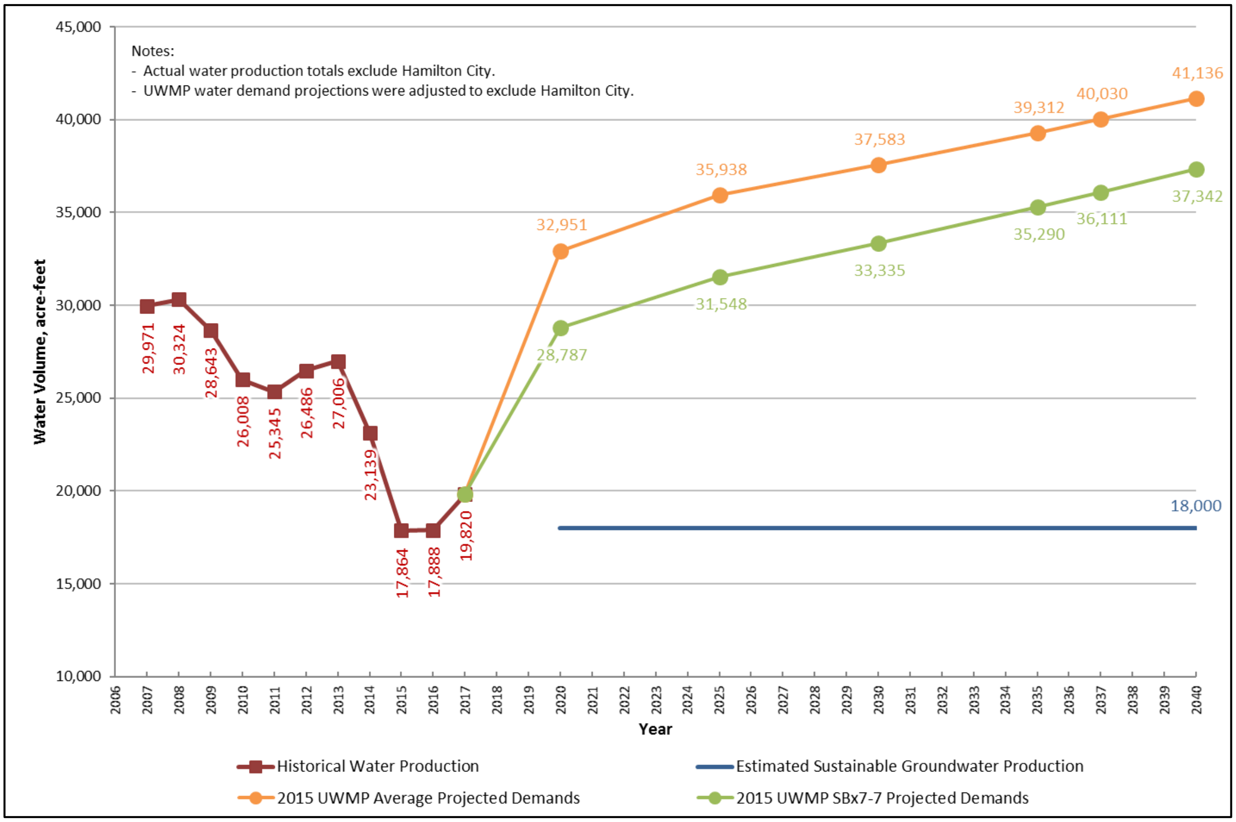


Recommended Project Delivery Requirement

Based on the most recent available data for groundwater levels in the surrounding Chico urban area and the District's historical groundwater production data, an annual groundwater production volume of 18,000 af/year appears to be a reasonable, conservative estimate of the recommended sustainable yield for groundwater pumping from the aquifer underlying the District at this time. The actual sustainable yield will be determined by the County though the development of the GSP.

Figure 4 illustrates the difference between the District's projected water demands and current estimated sustainable groundwater production. As described above, the District's projected buildout (2040) demands range from approximately 37,000 af/yr to 41,000 af/yr. This indicates that the additional supply needed to meet the projected demands above the current baseline groundwater production ranges from 19,000 af/yr to 23,000 af/yr. Therefore, the recommended supply delivery requirement is approximately 20,000 af/yr, consistent with the volume that was originally evaluated in Phase 1 of this Study. This recommendation should support compliance with SGMA and simultaneously meet the District's projected future water demands. However, as discussed above, this supply delivery requirement would need to be re-evaluated periodically to determine if the new State mandated conservation requirements or the permanent influx of residents from the Town of Paradise would significantly impact the District's future water demands.

Figure 4. Updated Project Delivery Requirements



SOURCE WATER SUPPLY OPTIONS

As noted previously, the original intent of the Study was to use the County's State Water Project Table A contract water. This current phase of the Study (Phase 6) includes an assessment of other potential supply sources in addition to Table A supply. The following other supply sources were evaluated: Feather River Settlement Contractors, South Feather Water and Power Agency, Butte Creek Water Rights Holders, and M&T Ranch Sacramento River Settlement Contractors. Each potential supply source is discussed in more detail below, including amount of water potentially available, reliability, and timing of supply, and potential cost, if available.

An important consideration for any water supply source is the ongoing process to update the State Water Board's Bay-Delta Water Quality Control Plan (Bay-Delta Plan). The update is evaluating three types of requirements: 1) minimum tributary flow requirements; 2) protection of cold-water habitat; and 3) minimum Delta outflow requirements. Phase II of the process is evaluating the Sacramento River and its tributaries. In July 2018, the State Water Board completed a framework plan for the Sacramento River and tributaries, with recommendations to propose flow standards of 45 to 65 percent of the system's unimpaired flow (the flow that would exist in the absence of diversion and storage), with 55 percent as a starting point. In comparison, historical diversions are estimated to have reduced inflow to the Delta by more than 50 percent. State Water Board staff is currently developing a Staff Report/Substitute Environmental Document (SED) that will evaluate

the proposed framework recommendations and alternatives. After public review, the State Water Board will consider public comments, prepare responses, and identify any changes to the proposed Bay-Delta Plan.

In a separate but parallel process, the California Natural Resources Agency is working with water users to negotiate voluntary settlement agreements (VSAs) to develop non-flow measures, as well as flow measures to restore habitat for native fish species. The framework includes provisions to relax minimum inflow standards to as low as 45 percent of unimpaired flow and develop non-flow measures that provide an equivalent level of protection to increased flow requirements. Western Canal Water District and the Joint Board Districts are participating in the voluntary settlement agreement negotiations.

In the Feather River watershed, the emphasis has been on programs to address flow, temperature, and funding to acquire flows to increase Delta outflows and additional habitat restoration. To help with the sustainable growth of fish during migrations, commitments were made by stakeholders to:

- In specific dry water years, dedicate 50,000 af of spring and summer water to environmental flows made available through the fallowing of 11,000 acres of agricultural production
- Dedicate 43,000 af of pulse flows for 14 days between January and April of each year
- Provide temperature controls
- Modify current operations of Oroville Dam to maximize flows on the Feather River for fish health
- Provide habitat restoration projects to help with floodplain access such as Nelson Slough to encourage floodplain rearing resulting in bigger fish migrating through the Delta
- Provide adaptive fish predator management

Butte County State Water Project Table A

Supply Overview

Butte County (County) has a long-term surface water supply contract with the California Department of Water Resources (DWR) for receipt of up to a maximum amount of 27,500 af/yr from DWR's State Water Project (SWP), as designated in Table A of the surface water supply contract (Table A supply). Actual annual water deliveries from the SWP are typically less than the designated Table A amounts and depend on several factors including hydrologic conditions, operational constraints, Bay-Delta water quality objectives, and customer demand. Of the total SWP contract allocations of 4.2 million acre-feet (MAF), the currently estimated long-term average annual deliveries total 2.6 MAF, or about 62 percent of the total contract allocations.

Historically, the County's contract was subject to the same cutbacks as other State Water Contractor contracts. In 2013, the County settled litigation with DWR regarding Butte County's area of origin or county of origin contract rights. The settlement agreement provides a full contract allocation to the County when SWP South of Delta allocations are 60 percent or higher. For South

of Delta allocations of 25 to 55 percent, the County gets the South of Delta allocation plus 30 percent. For South of Delta allocations of 0 to 20 percent, the County's allocation ranges from approximately 10 percent to 22 percent of its contract amount, on a graduated scale. The current (2019 final) allocation from the SWP is 70 percent, so the County's 2019 allocation will be 100 percent.

The County currently has a contract with Cal Water Oroville District for the purchase of 150 af/yr for emergency purposes, and a contract with Del Oro Water Company for 300 af/yr.

Prior to 2008, the County had flexibility to reduce its Table A amount to reflect actual usage and was only required to pay for its reduced requested Table A amount. Beginning in 2008, DWR required the County to pay for its full Table A allocation whether it was taken or not. Therefore, the County transferred its surplus Table A allocation to another SWP contractor from 2008 through 2009. In 2011, the County entered into a lease agreement to provide 24,000 acre-feet of its Table A allocation to Palmdale Irrigation District and the Westside Districts (Dudley Ridge Water District and members of the Kern County Water Agency). This agreement was extended, and the County's current agreement runs through 2035.

If Table A water were to be used for this Project, it would not be available until 2035, unless the County terminates the lease agreement prior to its expiration.

Water Cost

Typical SWP contracts require payment on the full Table A allocation, regardless of the actual amount of water delivered, and water used for this Project would be subject to these payment terms. Cost components in the contract include a Delta Water Charge, which covers the repayment costs for SWP Oroville, Delta, and San Luis Reservoir facilities, and a Transportation Charge, which covers repayment for facilities used to convey water to different service areas. The County pays only the Delta Water Charge. The total charge for the County in 2017 was $2.24 million, or $81/acre-foot of the Table A allocation.

The County leases its water at cost plus an administrative delivery fee. Initial administrative fees were $50/acre-foot. The contract includes an escalation clause, so the current administrative fee is about $70/acre-foot. Revenue generated from the administrative fee goes to the County General Fund.

If water were to be purchased for the Project, it is anticipated that terms would be similar to the current lease agreement, with pass through of the purchase cost and an administrative fee.

Feather River Settlement Contractors

Supply Overview

Western Canal Water District (WCWD) and the Joint Board Districts (Richvale Irrigation District, Butte Water District, Biggs-West Gridley Water District, and Sutter Extension Water District) hold pre-1914 water rights on the Feather River. DWR has settlement contracts with each entity, executed to settle protests regarding the construction of SWP Feather River facilities. DWR supplies water to Feather River Settlement Contractors from Lake Oroville via Thermalito Afterbay.

WCWD purchased the Western Canal Company water system from Pacific Gas & Electric (PG&E), who had acquired it from Great Western Power Company. WCWD has surface water rights that include 150,000 acre-feet of natural flow of the Feather River, subject to dry-year reductions, as well as 145,000 acre-feet of upstream stored water, stored in the North Fork Feather River power generation project, that is not subject to reduction.

The Joint Board Districts purchased pre-1914 water rights and property of the Sutter-Butte Canal Company. The Joint Board Districts have surface water rights that include 555,000 acre-feet of natural flow of the Feather River, subject to dry-year reductions. Water is allocated to individual members as follows: Richvale Irrigation District - 150,000 acre-feet; Butte Water District - 133,000 acre-feet; Biggs-West Gridley Water District - 161,000; and Sutter Extension Water District - 111,000 acre-feet.

Dry-year supplies for WCWD and the Joint Board Districts are highly reliable. When dry-year reductions are required, WCWD and the Joint Board Districts supplies can be reduced by up to 50 percent in any one year, but not more than a cumulative total of 100 percent over a consecutive seven-year period. Historically, cutbacks have occurred in 1977, 1991, 1992, and 2015.

DWR contracts with agencies include the above quantities, which are allowed to be diverted during the irrigation season, defined as April 1st to October 31st. The contracts also allow for reasonable beneficial use of an unquantified amount during the period November 1st through March 31st. Historically, districts have used water during the winter period for decomposition of rice straw following harvest. DWR contracts do not allow transfer of water outside of the district service areas without prior written consent of the State.

WCWD and the Joint Board Districts have anywhere from 10,000 to 100,000 acre-feet of supply that is not used, depending on the hydrologic year, with more water available in wetter years. Transfers of water may not be feasible in all years but could be paired with other supply sources to provide a supply for the Project (Trimble, 2018).

Subsequent discussions with Butte Water District indicate that supply from their district might be the best fit for the Project. West Yost and Cal Water met with Mark Orme, General Manager of Butte Water District, and Charlie Etcheverry, board member, on February 20, 2019 to discuss the potential to provide supply to this Project. Butte Water District has about 30,000 af/yr of water that it is not able to use because it's surface water deliveries have decreased over time, as growers within the district have converted to groundwater use or land has gone out of production. Butte Water District would be interested in selling water to Cal Water using the revenue to fund maintenance programs for their irrigation customers and to keep agricultural water rates low (Orme, 2019). However, a supply from Butte Water District would still need to be paired with another supply source to provide a year-round supply.

To deliver water from Butte Water District, new conveyance facilities would be required to convey water north from Thermalito Afterbay, or through an exchange agreement with a Sacramento River Federal Water Contractor, such as M&T Ranch under the Department of Water Resources and Bureau of Reclamation Coordinated Operating Agreement.

Water Cost

Water cost was not discussed with Butte Water District representatives. However, this water supply would need to be priced at a rate that would enhance the district's annual revenue, allowing it to maintain facilities and keep costs low for their current users.

South Feather Water and Power Agency

Supply Overview

South Feather Water and Power Agency (South Feather) has pre-1914 and appropriative water rights totaling 800,000 af/yr, a total that is more water than is available from the watershed. South Feather's pre-1914 rights derive from the gold-rush era Feather River and Ophir Water Company, which delivered water to mining sites in the area for hydraulic mining. South Feather's predecessor agency, the Oroville Wyandotte Irrigation District (OWID), was formed in 1919. In the late 1950s and early 1960s, OWID proposed and constructed the South Fork Power project which includes 8 dams, 17 tunnels, 21 miles of canals and conduits, 4 hydroelectric power plants, and 21 miles of road. The South Fork Power project was completed in 1963.

Water from the facilities is delivered to North Yuba Water District to satisfy its senior water rights, and power is sold to PG&E. The South Fork Power project diverts water principally from the South Fork of the Feather River and also from Slate Creek, a tributary to the North Yuba River. The South Fork Power project includes four reservoirs on the South Fork Feather River, with a combined storage of 172,000 acre-feet. The two largest reservoirs, Little Grass Valley Reservoir and Sly Creek reservoir (154,000 acre-feet combined) are operated to capture spring runoff and are then drawn down over summer and fall for power generation, irrigation, and consumptive uses. The last powerhouse, Kelly Ridge Powerhouse, discharges to the Feather River just downstream of the Hyatt Powerhouse tailrace, below Oroville Dam. The Kelly Ridge Powerhouse is operated as a baseload facility and can discharge up to 255 cubic feet per second (cfs). The combined flow from Kelly Ridge and Hyatt Powerhouses flows downstream to Thermalito diversion dam. If water were obtained for this Project, it could be delivered to the canal connecting the Thermalito Forebay and Thermalito Afterbay, at locations previously analyzed in earlier phases, or at Thermalito Afterbay.

South Feather has contractual rights to the consumptive use of 33,000 af/yr and delivers treated water to approximately 6,700 households in the City of Oroville, and seasonal irrigation water to over 500 customers. South Feather's contract with PG&E requires payment to PG&E for water diverted exceeding this amount. South Feather is also required to provide Yuba County Water District up to 23,700 af/yr to satisfy prior rights. South Feather is also required to maintain water levels in Little Grass Valley Reservoir of at least 5,023 feet elevation (compared with 5,047 feet maximum water surface) for recreational purposes through September 15th. Sly Creek Reservoir does not have drawdown restrictions and is typically drawn down by 100 feet during a typical water year (South Feather, 2010). It is currently unknown how upstream reservoir operations and environmental water obligations would affect seasonal deliveries to the Project.

If Cal Water were to purchase water from South Feather, it would use water under the Agency's consumptive use rights. According to Cal Water (Barber, 2019), the Agency delivers about 15,000 af/yr for its agricultural and municipal customers.

As of July 2019, South Feather is reviewing its water rights and is developing strategies to work with others to provide water for environmental benefits. South Feather is embarking on a study, working with its water rights attorney and water rights engineer to evaluate potential uses of water. Cal Water should continue to follow up with South Feather as this study progresses.

Water Cost

No information was obtained on potential cost for purchase of water from South Feather.

Butte Creek Water Rights Holders

Flows in Butte Creek are a combination of native water from Butte Creek and its tributaries and imported water from the West Branch of the Feather River, delivered to Butte Creek via the DeSabla Centerville hydroelectric project's Hendrick's Canal.

Both native and imported water are allocated based on an adjudication of Butte Creek in 1942. The adjudication defines four groups of rights: special, 1st priority, 2nd priority, 3rd priority and surplus rights, and allocates rights for Little Butte Creek, upper Butte Creek (above Little Butte Creek), and lower Butte Creek (below Little Butte Creek). The adjudication allocates pre-1914 rights, riparian rights, and appropriative rights in the system. Larger rights holders on the creek include Paradise Irrigation District (PID), M&T Ranch, Gorrill Ranch, Rancho Esquon, Dayton Mutual Water Company, Durham Mutual Water Company, and Western Canal Water District.

PID holds two storage rights, totaling 18,300 acre-feet and a second priority class direct diversion right for 8 cfs on Little Butte Creek. PID stores water in Paradise Lake and Magalia Reservoir, and has a required year-round instream release of 0.5 cfs from Magalia Reservoir.

M&T Ranch holds 1st priority rights to divert water imported from the DeSabla-Centerville project of up to 106 cfs.

A meeting was held with M&T Ranch in September 2018 to discuss possible use of Butte Creek as a source of supply. Les Heringer, M&T Ranch Manager, indicated that due to the environmentally sensitive habitat on Butte Creek, any water rights changes to accommodate a project would be very challenging. He noted that 30 years ago, M&T Ranch applied for a new place of use for its water rights and found the process very challenging at that time. He also noted that water is available in Butte Creek only in wetter years, but in drier years, Butte Creek supply is limited due to environmental restrictions and calls on the water for in-stream fish flows.

M&T Ranch Sacramento River Settlement Contractors

In addition to its Butte Creek water supply, M&T Ranch has pre-1914 water rights on the Sacramento River. M&T Ranch has a settlement contract with the United States Bureau of Reclamation (USBR), executed to settle protests regarding the construction of USBR Federal Water Project facilities on the Sacramento River. The current contract runs through 2045.

M&T's contract is for 16,980 acre-feet of Base Supply and 976 acre-feet of Project Water. Base Supply is the quantity provided under the contract based on M&T's senior water right. Project Water is Central Valley Project (CVP) contract water, which is provided in excess of the Base

Supply via a water supply contract with the CVP. Base Supply is provided at no cost. Project Water is provided at the CVP water rate. Regardless of actual use, M&T Ranch must pay for 75 percent of the Project Water contract amount each year and pay for actual diversions that exceed 75 percent of the Project Water contract amount. The 2019 water rate for M&T Ranch is $31/acre-foot.

Base Supply is provided from April through October, based on the monthly schedule in the contract. Project Water is provided from June through September based on the schedule in the contract. Contract water cannot be transferred or exchanged without the written consent of the USBR.

Both the Base Supply and Project Water are subject to dry-year reductions. In a critical year, monthly deliveries are reduced by 25 percent. Critical years are defined as years in which forecasted inflow to Lake Shasta is less than 3.2 MAF or prior water year(s) had inflows less than 4 MAF; deficiencies in contract deliveries are below 4 MAF and the forecast deficiency is 800,000 acre-feet.

M&T's Sacramento River diversion structure has a capacity of 120 cfs. At times, M&T Ranch has used up to 110 cfs, but more typically averages about 60 cfs. M&T Ranch does not fully use its Base Supply. It provides water to both Llano Seco and to the wildlife refuge. It sells 1,000 acre-feet of Project Water to an entity in the Willows Area.

PRELIMINARY SCREENING OF POTENTIAL PROJECTS

As discussed above, SGMA provides new opportunities for Cal Water to partner with the agricultural or other community members. To develop an updated comprehensive list of possible projects, West Yost re-evaluated some of the projects previously identified and added new projects not previously considered. West Yost also reviewed the County's recently completed report on the Evaluation of Restoration and Recharge Within the Butte County Groundwater Basins[7] to include any feasible projects for preliminary screening.

Summary of Potential Projects

For each potential project, West Yost developed brief concept descriptions to describe the location of the project, general project features, information available, key issues, and data gaps. Attachment C provides the project information sheets for all potential projects included in the preliminary screening. During a workshop held on June 8, 2018, West Yost and Cal Water staff reviewed and screened all the potential projects to identify concepts that should be further evaluated. In particular, potential water supply sources, conveyance options, and end-use options (e.g., groundwater recharge vs. water treatment plant) were discussed.

[7] Dated January 2018 and prepared by GEI Consultants, Inc.

Results of Preliminary Screening

Table 2 summarizes all of the potential projects included in the preliminary screening and identifies the projects recommended for further evaluation from the workshop. Based on results from the preliminary screening, the following three alternatives were selected for further evaluation:

- Radial Collector Wells along the Sacramento River
- Regional Partnership with SWP Feather River Settlement Contractors and Agricultural Groundwater Users of Butte County
- Partnership with M&T Ranch Using Butte Creek Water Rights

The following section discusses the findings from West Yost's additional evaluation of the three selected alternatives.

EVALUATION OF SELECTED ALTERNATIVES

West Yost held numerous meetings and conference calls with various stakeholders within the County to develop a refined conceptual level evaluation of selected alternatives. During the discussions and through our research, West Yost collected data to better define each project, which included the following if available:

- Source Water Supply Options
- Potential Partners
- Quantity of Supply Available
- Facilities Required
- Political and Institutional Considerations
- Environmental Considerations
- Operational Considerations
- Conceptual-Level Costs (capital and operational)
- Implementation Issues

Each selected alternative was then refined with additional data identified during this evaluation. The key findings for each selected alternative are summarized in Table 3. It should be noted that conceptual costs were not further developed due to the change in the Study progression as discussed below.

Table 2. Summary of Potential Projects Included in the Preliminary Screening[a]

Alternative ID	Project Name	General Project Description	Key Issues	Recommended for Additional Evaluation
A	Regional Partnership with Paradise Irrigation District (PID)	• Partner with PID to deliver treated water to Cal Water via expansion of their existing facilities — Expand PID Water Treatment Plant (WTP) from 16 mgd to 20 mgd and use available capacity to treat water for delivery to Cal Water — Deliver between 8 to 10 mgd via 10 miles of 24-inch diameter transmission main to the Chico District during normal and wet years • Possibly partner with City of Chico to include wastewater delivery	• Institutional and political constraints (DWR, PID) • Uncertainty regarding availability of supply and facilities (PG&E)	No
C	Regional Partnership with Del Oro Water Company, Lime Saddle District	• Partner with Del Oro Water Company to treat Table A water for delivery to Cal Water — Specific facilities have not been defined	• Political constraints (Del Oro WC, PID) • Difficulty in construction (volcanics in soil, landfill) • No grant funding would be available	
D	Regional Partnership with South Feather Water and Power Agency (SFWPA)	• Partner with SFWPA to purchase excess water and convey it to the Chico District via open channel, pipeline or combination of open channel and pipeline — Pipeline/channel alignment to Chico District could follow Oro-Chico Conduit and/or Sac Northern Railroad — Specific facility sizing has not been defined	• Operational constraints (supply originates from upstream of Lake Oroville) • Institutional constraints (revenue from power generation would be priority)	
G, H, I	Pipeline and/or Canal Conveyance from Thermalito Afterbay to Chico District	• Construct pipeline and/or canal from Thermalito Afterbay to Chico District along the former Oro-Chico Conduit or Sac Northern Railroad alignments — 19 miles of transmission pipeline/canal along the Oro-Chico Conduit alignment or 18 miles of transmission pipeline/canal along the former Sacramento Northern Railroad alignment — Pipelines were sized at 42-inch diameter to convey 18 mgd	• Cost constraints due to length of pipeline	
J	Partnership with M&T Ranch Using Existing Sacramento River Diversion Facility	• Partner with M&T Ranch to use their available pumping capacity at existing diversion structure in Sac River — Would require new booster pumping capacity at existing diversion and 5 miles of transmission pipeline to Chico District — Specific facility sizing has not been defined	• Operational constraints (gravel bar at diversion facility) • No grant funding would be available	
Alternative ID	**Project Name**	**General Project Description**	**Reasons for Additional Evaluation**	**Recommended for Additional Evaluation**
B	Radial Collector Wells along the Sacramento River	• Coordinated agreement would be used to exchange CVP/SWP water; USBR would release water from Lake Shasta for diversion, and DWR would release the same quantity of water from Lake Oroville — Install two radial wells adjacent to Sacramento River, 9 mgd each, and 6 miles of 42-inch diameter transmission main in Hwy 32 to new WTP in Chico District	• Potential partnerships (City of Chico, Agricultural Groundwater Users of Butte County) • Shorter conveyance pipeline length	Yes
E	Regional Partnership with SWP Feather River Settlement Contractors[b]	• Partner with SWP Feather River Settlement Contractors to purchase surplus water in normal and wet years and convey it to the Chico District via open channel, pipeline or combination of open channel and pipeline — Pipeline/channel alignment to Chico District could follow Oro-Chico Conduit and/or Sac Northern Railroad — Specific facility sizing has not been defined • Could be combined with Alternative F	• Pre-1914 water rights available during wet years • Supply for North County agricultural users or recharge	
F	Regional Partnership with Agricultural Groundwater Users of Butte County[c]	• Partnership would be in conjunction with another concept(s) to provide benefits to this organization	• Could be partners for Alternative B and E	
K	Partnership with M&T Ranch Using Butte Creek Water Rights	• Partner with M&T Ranch to use excess water from its Butte Creek water right that is diverted to Comanche Creek — Specific facilities have not been defined	• Potential partnerships (M&T Ranch/Llano Seco, Gorrill Ranch, PID) • Potential to divert from Butte Creek if a new diversion point is approved • Diversion could be in close proximity to the District	

(a) Refer to Attachment C for additional details.
(b) Consists of southern Butte County water agencies with pre-1914 water rights, who entered into settlement agreements with DWR that acknowledge their prior rights and specify how water will be delivered to these agencies.
(c) A 501 (c)(6) organization comprised of groundwater users within Butte County that aren't customers of public water agencies.

Table 3. Summary of Conceptual Level Evaluation of Selected Alternatives			
Evaluation Category	Radial Collector Wells along the Sacramento River	Regional Partnership with SWP Feather River Settlement Contractors and Agricultural Groundwater Users of Butte County	Partnership with M&T Ranch
Source Water Options	• 1. Feather River Settlement Contractor via water exchange (April – October only) • 2. South Feather Water & Power (year-round) (or Butte County Table A (year-round)) • 3. Potential CVP Settlement Contractors	• 1. Feather River Settlement Contractor (April – October only) • 2. South Feather Water & Power (year-round) (or Butte County Table A (year-round))	• 1. M&T Ranch CVP Contract Water (April – October only) (or Feather River Settlement Contractor) • 2. South Feather Water & Power (year-round) (or Butte County Table A (year-round)) • 3. Potential CVP Settlement Contractors
Potential Partners	• Feather River Settlement Contractor(s) • Butte County • South Feather Water & Power • M&T Ranch	• Feather River Settlement Contractor(s) • Butte County • South Feather Water & Power • Agricultural Groundwater Users • Durham Irrigation District	• M&T Ranch (or Feather River Settlement Contractor(s)) • Butte County • South Feather Water & Power
Quantity of Supply	• Cal Water Project Need: 20,000 AFY (18 mgd year-round) • Actual volume delivered depends on source water. Need multiple contracts for year-round supply. • Butte WD supply ~ up to 27,000 AFY[(a)], available April – October. Up to 50% reduction in drought years but only 2 out of every 7 years. • Butte County SWP contract depends on SWP South of Delta (SOD) allocation, with 55% when SOD is 25%, and 100% once SOD is 60% (reference the Area of Origin settlement contract). • South Feather Water & Power: TBD	• Cal Water Project Need: 20,000 AFY (may or may not be year-round) • Actual volume delivered depends on source water. Need multiple contracts for year-round supply. If summer-only delivery may have single source of supply. • Butte WD supply ~ up to 27,000 AFY, available April – October. Up to 50% reduction in drought years but only 2 out of every 7 years. • Butte County SWP contract depends on SWP South of Delta (SOD) allocation, with 55% when SOD is 25%, and 100% once SOD is 60% (reference the Area of Origin settlement contract). • South Feather Water & Power: TBD	• Cal Water Project Need: 20,000 AFY (18 mgd year-round) • Actual volume delivered depends on environmental and climatic factors determined annually by USBR and DWR. • M&T Ranch CVP total contract ~18,000 AFY, available April – October. Up to 25% reduction in critical years. • Butte WD supply ~ up to 27,000 AFY, available April – October. Up to 50% reduction in drought years but only 2 out of every 7 years. • Butte County SWP contract depends on SWP South of Delta (SOD) allocation, with 55% when SOD is 25%, and 100% once SOD is 60% (reference the Area of Origin settlement contract). • South Feather Water & Power: TBD
Infrastructure Requirements	• Two radial collector wells (18 mgd) • 31,000 feet of 42-inch diameter pipeline from radial collector wells to deliver raw water to proposed water treatment plant • Water treatment plant (18 mgd) to treat raw water	• Pump station and pipeline to Durham area for farm delivery and/or recharge • New pump station along Thermalito Canal • 84,000 feet of pipeline along public roads to Durham area (alternate alignment using Oro-Chico Conduit route with canal/pipeline options). • Recharge facilities and/or farm surface water delivery systems	• Use of existing M&T intake available pump slot (23 mgd capacity) • Use of existing M&T canal for conveyance of water to Chico River Road • New pump station adjacent to M&T Main Canal • 19,000 feet of new 42-inch diameter pipeline along Chico River Road to Chico • Water treatment plant (18 mgd) to treat raw water
Political and Institutional Considerations	• Current alignment requires private easement through properties adjacent to Highway 32 • State Board and DWR process to expand Settlement Contractor place of use (Source 1) • Coordination between Federal and State water projects to exchange water under the Coordinated Operations Agreement (Source 1) • Reclamation contracting process (including NEPA) for long-term transfer (Source 1 or Source 3) • Agreement with County and DWR to wheel non-project water through Oroville (Source 2) • Potential local partners, not yet identified	• Current alignment along public roads east and west of Highway 99. Private easements required adjacent to Highway 99. • State Board and DWR process to expand Settlement Contractor place of use (Source 1) • Agreement with County and DWR to wheel non-project water through Oroville (Source 2) • Computation of benefits for recharge project and/or farm delivery project • Potential local partners, not yet identified	• Current alignment along public road • Requires agreement with M&T for use of existing facilities • State Board and DWR process to expand place of use if Feather River Settlement Contractor supply • Reclamation contracting process (including NEPA) for long-term transfer (Source 1 or Source 3) • Coordination between Federal and State water projects to exchange water under the Coordinated Operations Agreement if Feather River Settlement Contractor supply • Agreement with County and DWR to wheel non-project water through Oroville (Source 2)
Environmental Considerations	• New in-stream flow requirements for Sacramento River and potential restrictions to manage cold-water pool in Shasta • Impacts to Federally-listed endangered fisheries in the Sacramento River (anticipated to be less than with a conventional surface water diversion) • NEPA and CEQA compliance	• CEQA compliance • Stream crossings	• New in-stream flow requirements for Sacramento River and potential restrictions to manage cold-water pool in Shasta • NEPA and CEQA compliance

Table 3. Summary of Conceptual Level Evaluation of Selected Alternatives			
Evaluation Category	Radial Collector Wells along the Sacramento River	Regional Partnership with SWP Feather River Settlement Contractors and Agricultural Groundwater Users of Butte County	Partnership with M&T Ranch
Operational Considerations	• Potential yield and water quality is dependent on hydrogeologic and geochemical conditions • Possible restrictions on diversions due to temperature control requirements and potential new in-stream flow requirements for spring-run salmon	• Delivery requirements dependent on Ag needs, if farm delivery • Need to identify areas for recharge and/or delivery	• If using M&T canal, higher losses in winter months when M&T not conveying agricultural water • Possible restrictions on diversions due to temperature control requirements and potential new in-stream flow requirements for spring-run salmon
Advantage(s)	• Project would require a much shorter transmission pipeline than conveying water from Lake Oroville • Sub-surface diversion easier to implement than new surface diversion • Lower turbidity and organic material would require less capital and O&M costs for treatment • Avoid potential sediment transport/deposition issues in Sacramento River • Fewer partners to coordinate with	• More opportunity for partnership, grant funding for public agency participation • State and local (County) involvement only	• Cal Water only project with partners only for water purchase and use of M&T facilities • Existing diversion facility with available capacity • Shortest pipeline route for conveyance to Chico • Pipeline in public easement
Disadvantage(s)	• More expensive than a conventional screened diversion structure • Potential to impact groundwater levels for nearby wells • Surface water deliveries may be curtailed in some dry years to meet CVP temperature control requirements and/or instream flow requirements • Fewer opportunities for grants with partners • Private easements needed	• Long-distance pipeline or pipeline/canal from southern part of County to Durham/Chico area • More complex project with more partners	• Would require Cal Water to share costs in existing diversion facility maintenance • Some risk that M&T would re-locate diversion downstream of current location • Surface water deliveries may be curtailed in some dry years to meet CVP temperature control requirements and/or instream flow requirements
(a) 27,000 AFY = 20 percent of Butte Water District water right not currently used (per Butte County Water Inventory).			

Summary of Findings

Although the original intent of this Study was to screen these three selected alternatives down to two preferred alternatives for further evaluation, there were three significant events that happened during the evaluation of selected alternatives that altered the course of this Study:

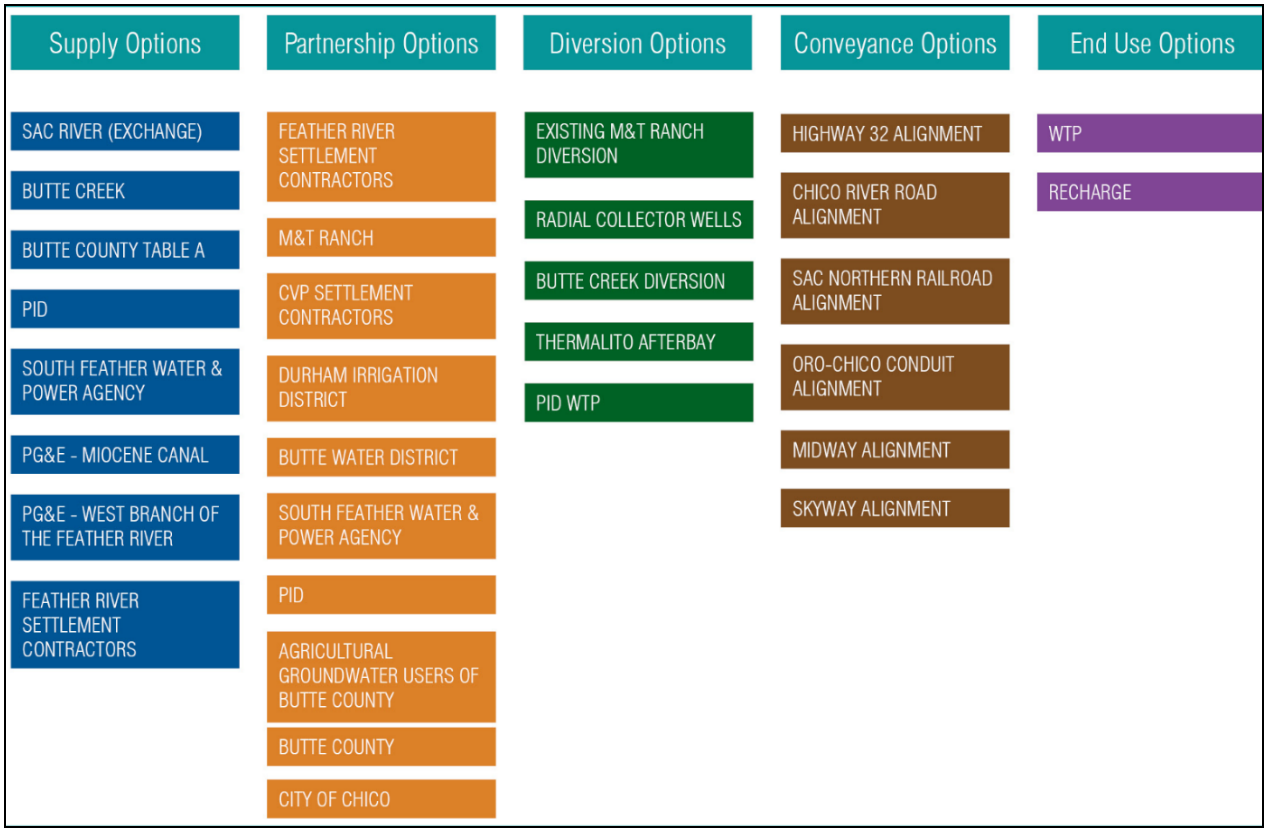
1. The County held a meeting on October 15, 2018 with various stakeholders[8] to determine how to best conjunctively use available surface water and groundwater supplies within Butte County
2. The Camp Fire started on November 8, 2018 and caused widespread destruction in the Town of Paradise
3. Cal Water officers requested West Yost to present the current Study findings at a meeting held on June 17, 2019

County Meeting

Findings from the County meeting indicated that additional feasibility level studies to develop projects that will be supported by stakeholders are needed. County staff plan to lead additional Working Committee meetings to continue to identify and evaluate projects for consideration by all stakeholders. Through the initial County meeting, it was also apparent that it would be helpful to provide a better overview of available surface water supplies and potential regional partnerships and projects that have been identified by Cal Water and West Yost to date. Therefore, West Yost worked on summarizing the potential supply, partnership, diversion, conveyance, and end use options. Figure 5 illustrates the various potential project options to increase conjunctive use of available surface water and groundwater supplies in the County. If feasible, projects that are supported by the majority of the stakeholders to achieve groundwater sustainability could be included in the GSP.

[8] Attendees included staff from Butte County Department of Water and Resource Conservation, City of Chico, various Agricultural Groundwater Users, Durham Irrigation District, M&T Ranch, South Feather Water and Power Agency, Western Canal Water District, Cal Water, and West Yost.

Figure 5. Summary of Potential Supply, Partnership, Diversion, Conveyance, and End Use Options



Camp Fire

The destruction of the Town of Paradise from the Camp Fire provided a new opportunity to potentially use PID's Water Treatment Plant to provide an alternative supply to the District. However, there is currently widespread water quality issues (e.g., benzene) within the PID water distribution system. PID currently estimates that it would take four years to clean-up the widespread contamination. There are many other unknown variables at this time (including long-term availability), but it is recommended that Cal Water continue to consider and evaluate the PID Intertie project in coordination with the County because this project would provide an alternative water supply to the District and support other regional water supply objectives.

Cal Water Meeting

During the Cal Water officers meeting, West Yost presented the current Study findings and provided recommendations for the objectives and direction of the Study moving forward. West Yost recommended that Cal Water should continue to both partner with the County and local water users (though Working Committee and Larger Group meetings that are led by the County) as well as develop a stand-alone project that could potentially be implemented without extensive partnerships (e.g., use of Feather River supply with M&T Ranch conveyance). One primary advantage of partnerships is the opportunity for grant funding and shared costs. Partnering with

the County and local water users will also help advance Cal Water's philosophy to work collaboratively with all stakeholders to share burdens and benefits on an equitable basis, but this approach may take a much longer time until an actual project can be implemented. Therefore, Cal Water should also continue to advance a stand-alone project that could potentially be implemented sooner without extensive partnerships if needed.

CONCLUSIONS AND RECOMMENDED NEXT STEPS

As previously mentioned, this Study was developed to identify overall feasible water supply resiliency and reliability opportunities for Cal Water's Chico District. The District currently does not experience a lack of water supply, but there is no diversity in their supply that would help address future uncertainties in groundwater supply. West Yost's recommendation to continue to develop a diversified and resilient water supply for the District is consistent with Cal Water's tradition of being the stewards of municipal water supply in the City of Chico, as well as being proactive with evaluating feasible alternatives to provide reliable and resilient water supply to their customers.

In summary, based on the findings from West Yost's Phase 6 evaluation, it is recommended that Cal Water continue to both partner with the County and local water users as well as develop a stand-alone project that could potentially be implemented without extensive partnerships. These two options will provide Cal Water with the flexibility to implement a project to address the District's future water supply requirements and reliability.

Cal Water should also continue to consider and evaluate the PID Intertie project in coordination with the County. Although there are many unknown variables at this time, the PID Intertie project would provide an alternative water supply to the District and support other regional water supply objectives. West Yost is currently in the process of working with County staff to determine the next steps in the PID Intertie project feasibility evaluation.

It should be noted that although this Study has historically focused on the feasibility of utilizing surface water (since there was availability), there could also be other more feasible supply options that may provide a better benefit to Cal Water's customers that also support long-term groundwater sustainability. It is recommended that when the next phase of the Study is initiated, a more detailed and accurate understanding of Cal Water's obligations under the SGMA should be obtained. Cal Water should also re-evaluate the District's water demand projections to provide a more accurate future water supply requirement. A better understanding of these two components (supply constraints and needs) will help further identify what type of project(s) the District would need to implement to adequately serve their future water demands and provide a reliable and sustainable water supply.

REFERENCES

Butte County Department of Water and Resource Conservation, 2015, 2014 Water Year Groundwater Status Report, February 2015.

Butte County Department of Water and Resource Conservation, 2015, WaterSolutions (Volume 16, Issue 12), December 2015.

Butte County Department of Water and Resource Conservation, 2016, Water Inventory and Analysis Report, June 2016.

Cal Water, 2016, 2015 Urban Water Management Plan, June 2016.

Federal Energy Regulatory Commission, 2009, Final Environmental Impact Statement, FERC Project No. 2088-068, June 2009.

GEI, 2018, Evaluation of Restoration and Recharge Within the Butte County Groundwater Basins, prepared for Butte County Department of Water and Resource Conservation, January 2018.

South Feather Water and Power Agency, 2010, South Feather Power Project, FERC Project No. 2088, Initial Study and Environmental Checklist.

South Feather Water and Power Agency, 2018, 2015 Urban Water Management Plan, December 2018.

West Yost, 2008, Chico-Hamilton City District Water Supply and Facilities Master Plan, May 2008.

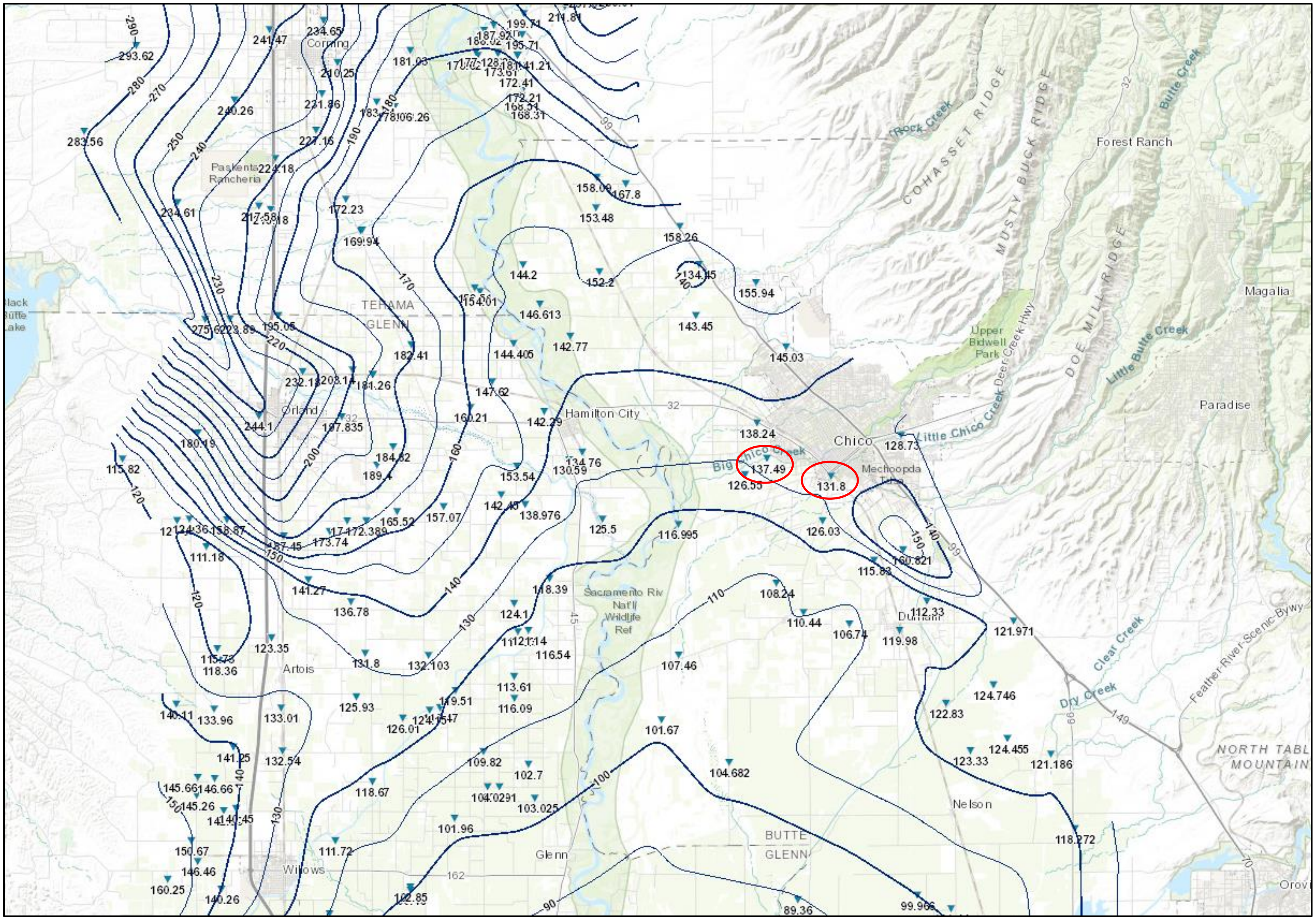
West Yost, 2012, Summary of Surface Water Delivery Estimate and Evaluation of Preliminary Surface Water Conveyance Projects TM, April 26, 2012.

West Yost, 2014, Surface Water Supply Feasibility Study for Cal Water's Chico District – Phase 3 – Project Justification TM, January 21, 2014.

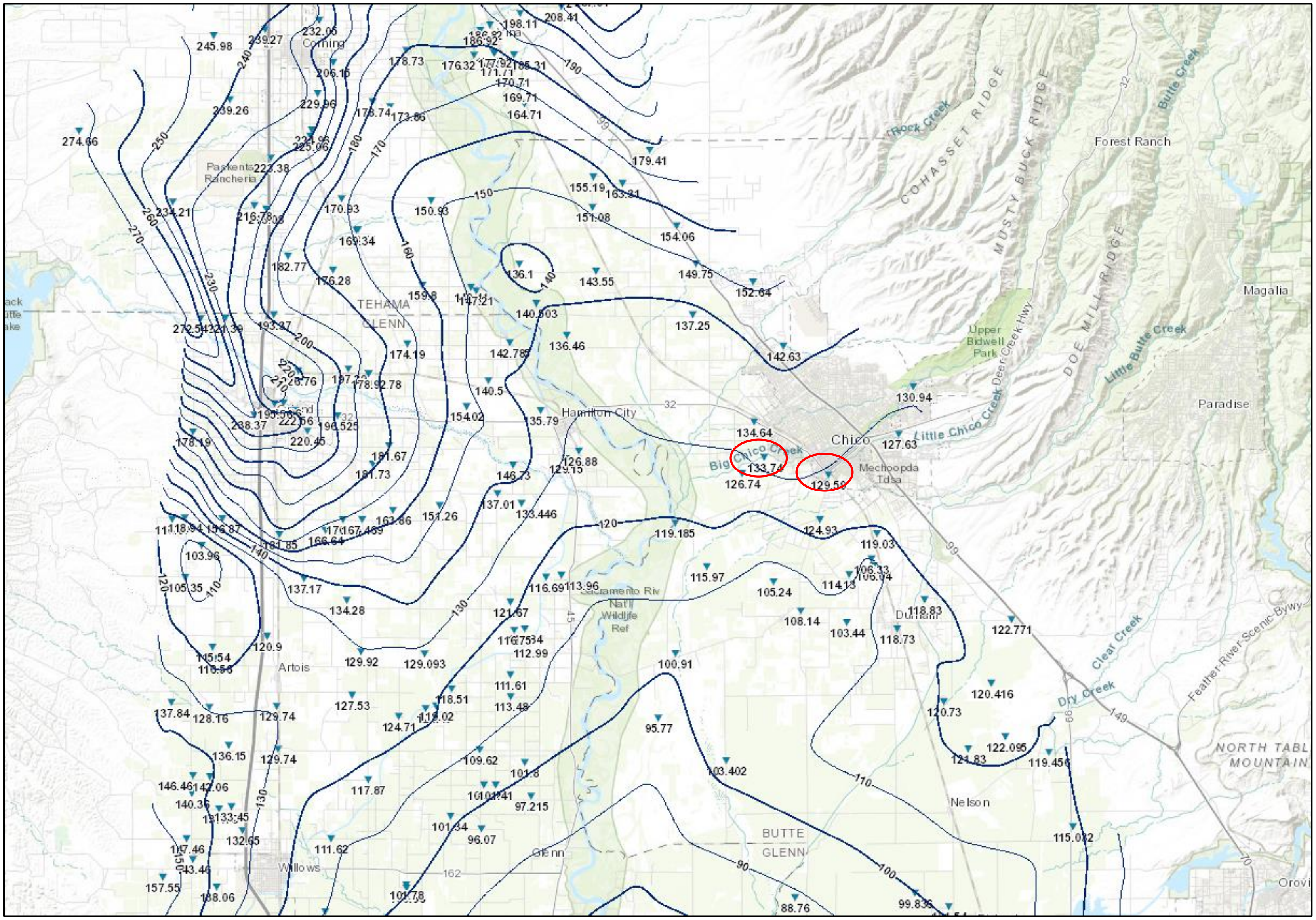
ATTACHMENT A

Spring Groundwater Elevation Estimate (2011-2017)
Groundwater Information Center Interactive Map Application (GICIMA)

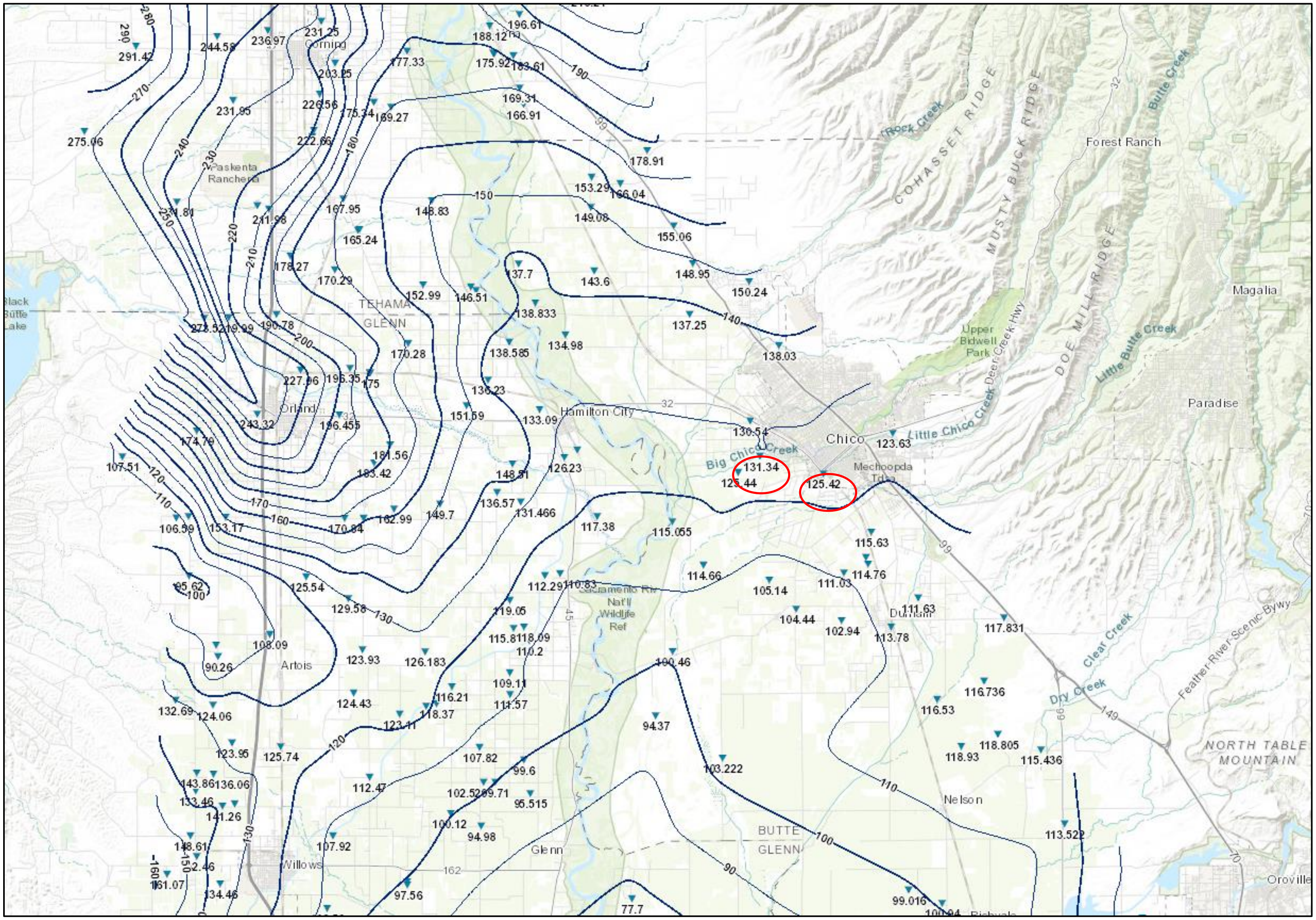
Spring 2011 Groundwater Elevations



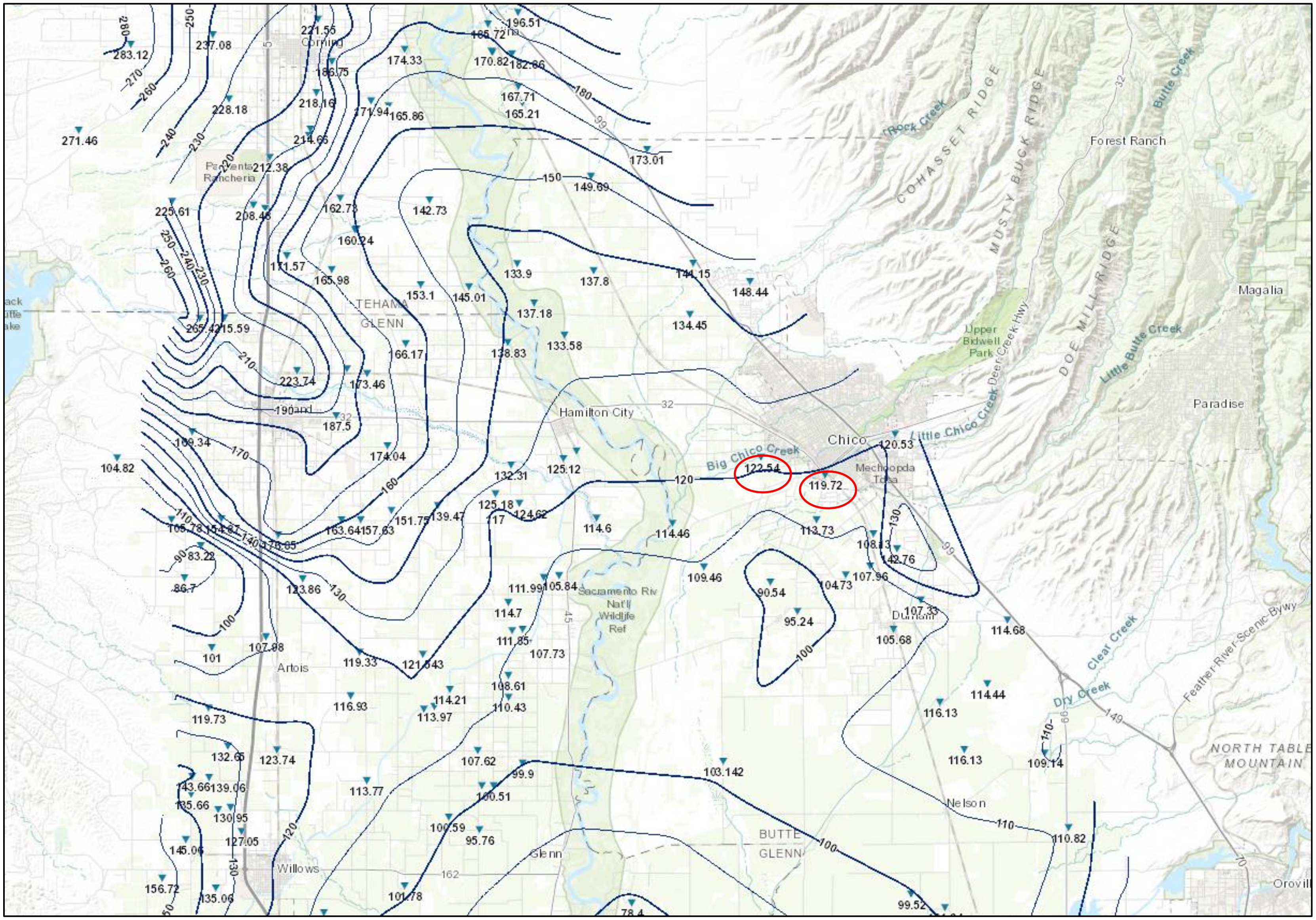
Spring 2012 Groundwater Elevations



Spring 2013 Groundwater Elevations



Spring 2014 Groundwater Elevations



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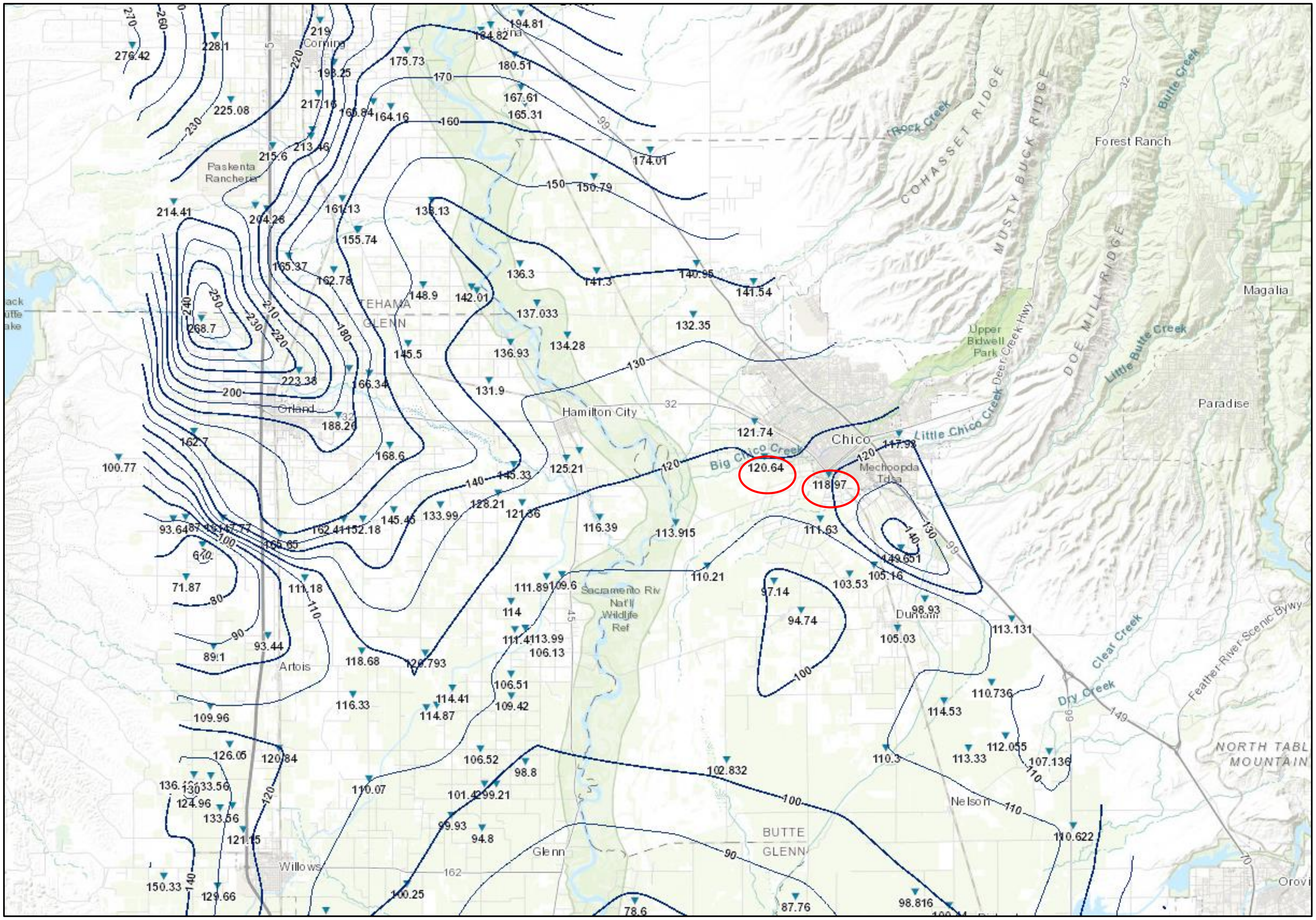
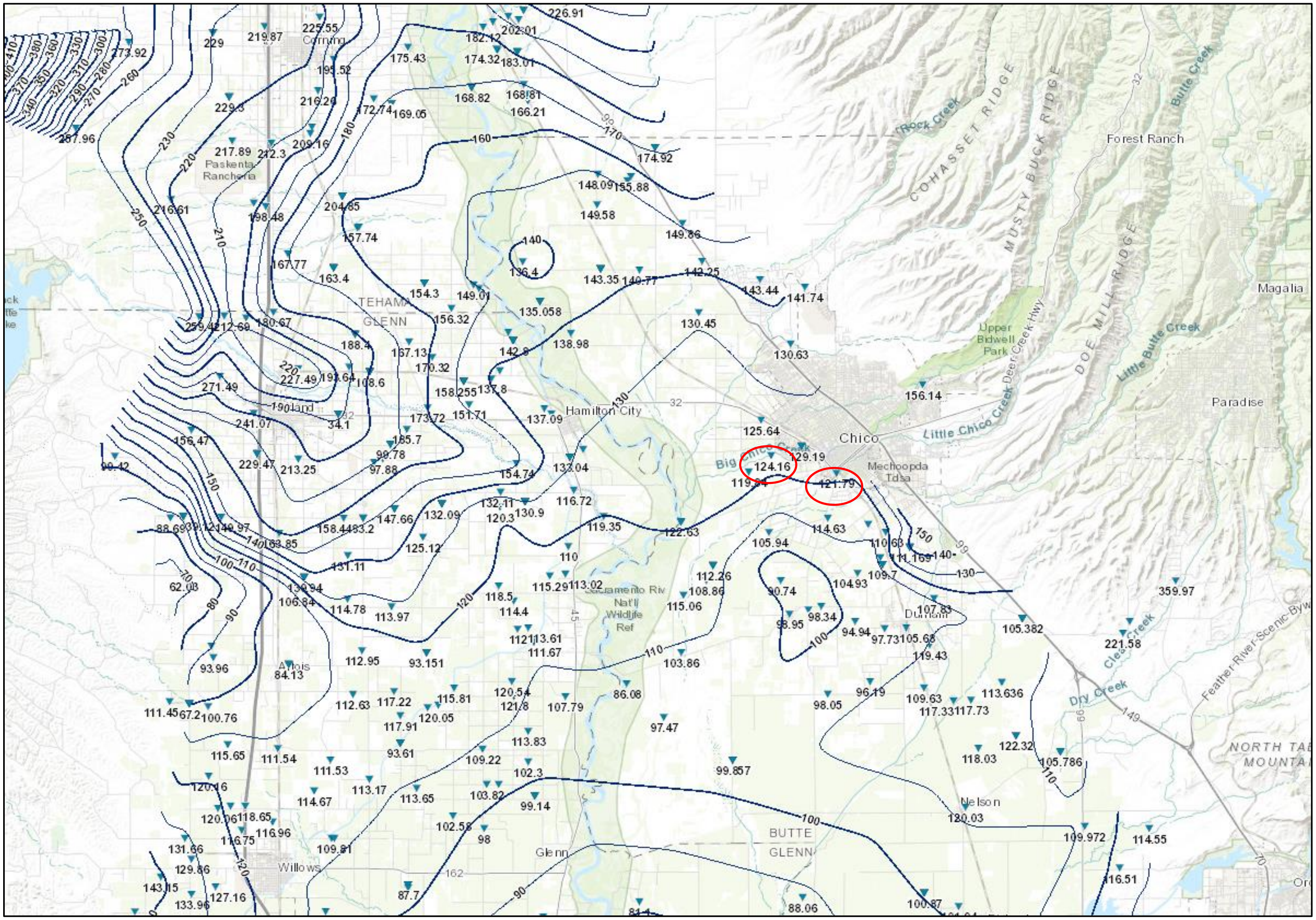
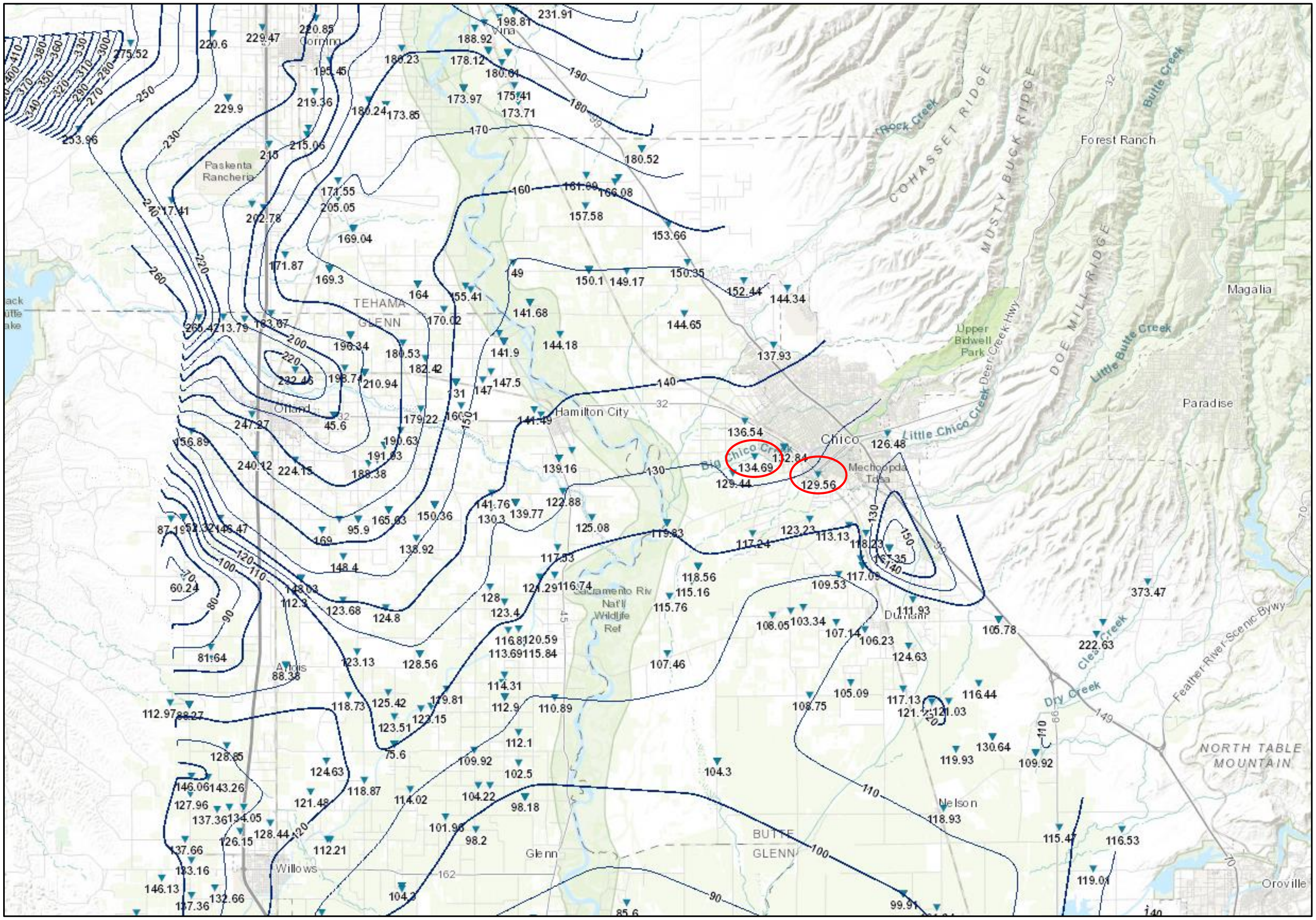


Spring 2016 Groundwater Elevations



Spring 2017 Groundwater Elevations



ATTACHMENT B

Water*Solutions* Newsletter, December 2015

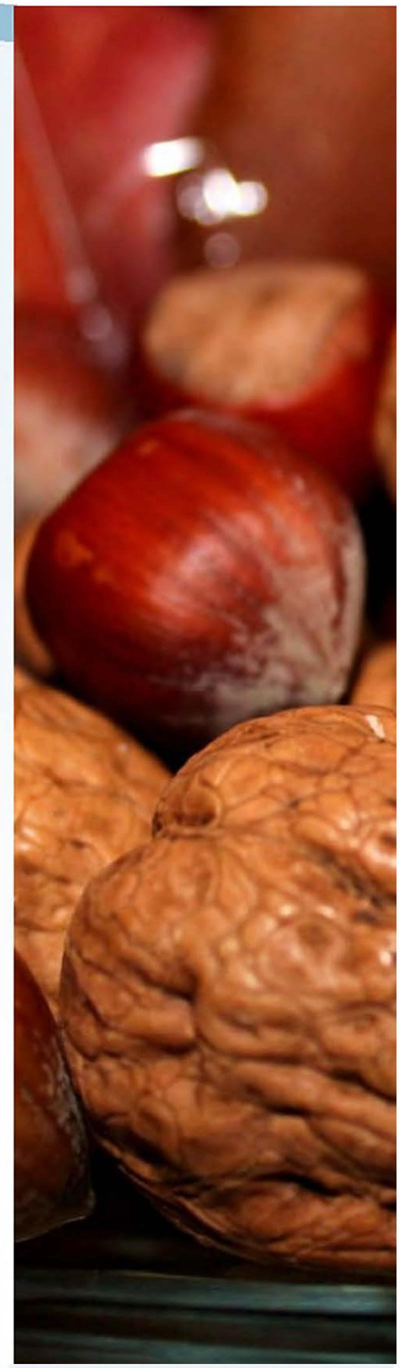
Butte County Water and Resource Conservation

Butte County Water & Resource Conservation

December, 2015
Volume 16, Issue 12

Water*Solutions*

"To manage and conserve water and other resources for the citizens of Butte County"



Exploring Basin Boundary Modifications

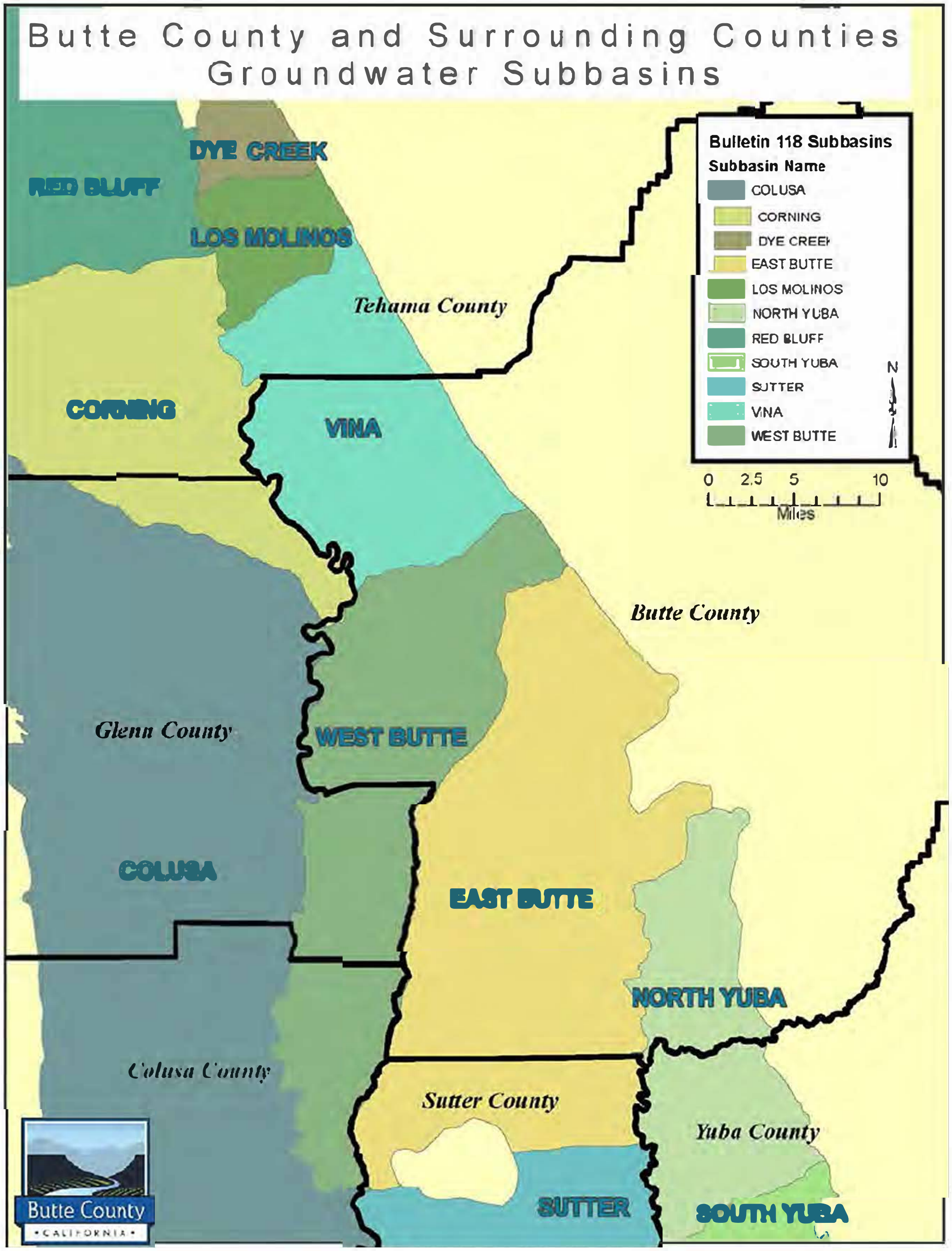
By Paul Gosselin

The Sustainable Groundwater Management Act (SGMA) went into effect on January 1, 2015. There are 127 subbasins designated by the California Statewide Groundwater Elevation Monitoring (CASGEM) program as high or medium priority that are subject to SGMA. In these subbasins, Groundwater Sustainability Agencies (GSA) must be formed by June 30, 2017. GSAs are responsible for developing and implementing Groundwater Sustainability Plans (GSP) by June 30, 2022. Butte County overlies four subbasins that are subject to SGMA: Vina (5-21.57); West Butte (5-21.58); East Butte (5-21.59) and North Yuba (5-21.60). Butte County and most of the other eligible local public agencies have elected to be GSAs. In the Vina subbasin, GSAs include Butte County, Tehama County Flood Control and Water Conservation District and the City of Chico. In the West Butte subbasin, there are six GSAs - Butte County, Glenn County, Colusa County, City of Chico, Western Canal Water District and Reclamation District 1004. In the East Butte subbasin, there are ten GSAs - Butte County, Sutter County, Biggs-West Gridley Water District, Richvale Irrigation District, Western Canal Water District, Butte Water District, City of Biggs, City of Gridley, Sutter Extension Water District and Butte College. In the North Yuba subbasin, there could be as many as seven GSAs. The GSAs in the North Yuba subbasin include Butte County, Yuba County Water Agency, City of Oroville, City of Marysville and Cordua Irrigation District. All of these subbasins extend in adjoining counties and some GSAs have jurisdiction in more than one subbasin.

BASIN MODIFICATIONS (page 2)>>>

Inside this issue

Basin Modifications



One of the upcoming decisions for GSAs is whether to request that the Department of Water Resources (DWR) modify basin boundaries. Although SGMA relies on the existing DWR Bulletin 118 basins as the starting point for managing groundwater, it is well-recognized that many of the Bulletin 118 basin boundaries do not reflect hydrology or foster sustainable groundwater management governance. As a remedy, SGMA gave local agencies the opportunity to request that DWR modify basin boundaries. DWR adopted regulations that describes the process for modifying basin boundaries. The regulations detail the types of basin boundary modifications; the information required; local agency consultation; and the criteria for approval. Local agencies have a variety of options for basin boundary modifications. However, modification requests must be supported by information, justification and meet the criteria for approval. DWR will give local agencies from January 1, 2016 to March 31, 2016 to submit any requests to modify basin boundaries.

The Department of Water Resources (DWR) is required by SGMA to adopt basin boundary regulations by January 1, 2016. After months of public consultation, DWR released the final basin boundary emergency regulations in October. The California Water Commission adopted the

Agribusiness Farm Tour

November is quite possibly my favorite month of the year. As days dwindle shorter and nights grow longer I look forward to the fresh smell of rain in the air, the comforting feeling of family gathered for the holidays, the still crisp mornings, and the Farm City Celebration Agri-Business Farm Tour.

The Farm City Celebration originated in 1979 when the California Women for Agriculture hosted a tasting of local products. Now, 35 years later, it has expanded to include the Dinner Dance, the Annual Kids Day on the Farm, the Agribusiness Farm Tour, and the Annual Harvest Festival. A full week to celebrate everything agriculture.

With warm coffee in hand and a scarf around my neck we boarded the bus at the Chico State Farm, anticipating a full morning of learning, laughter and fun. Led by Richard Price, recently retired Ag Commissioner, and Lee Herringer, Pest Control Advisor for M&T Ranch, this year's tour was taking us to the Paradise Ridge and Butte Valley where we would visit five of the area's ag related attractions.

regulations on October 21, 2015. The regulations will be filed with the Office of Administrative Law and will go into effect on January 1, 2016. The regulations allow for different types of basin boundary modifications and the required information will be specific to the type of modification.

Modifying existing basin boundaries may improve the ability to implement SGMA and achieve groundwater sustainability, but it will not change the fundamental elements of GSA governance or GSP implementation. Whether basins are modified, GSAs have many decisions on how to best develop, coordinate and implement one or more GSPs for their subbasin. Additionally, the need to coordinate with adjoining subbasins will be critical to successful implementation. With those considerations in mind, Butte County and other local agencies in the Vina, West Butte, East Butte and North Yuba subbasins are evaluating whether to request basin boundary modifications.

While a formal request to DWR is not required until the end of March, we are initiating an informal exploration of possible options for basin boundary modifications. For example, options could include consolidating one or more of the subbasins and/or modifying the basin boundaries along county lines. There are other options that could be advantageous including not making any change to the existing basins. The issues associated with basin boundary modifications are not new but will now take on a more important phase. As we enter 2016, more discussions and input will be sought on possible basin boundary modifications. One important source of input will come from the GSA Stakeholder Assessment Project. By March 2016 we and the other local agencies will have a clear picture on whether basin boundary modifications will be worth pursuing to advance implementation of SGMA. Please stay informed on basin boundary modifications by visiting our webpage at http://www.buttecounty.net/waterresourceconservation/SustainableGroundwaterManagementAct.aspx

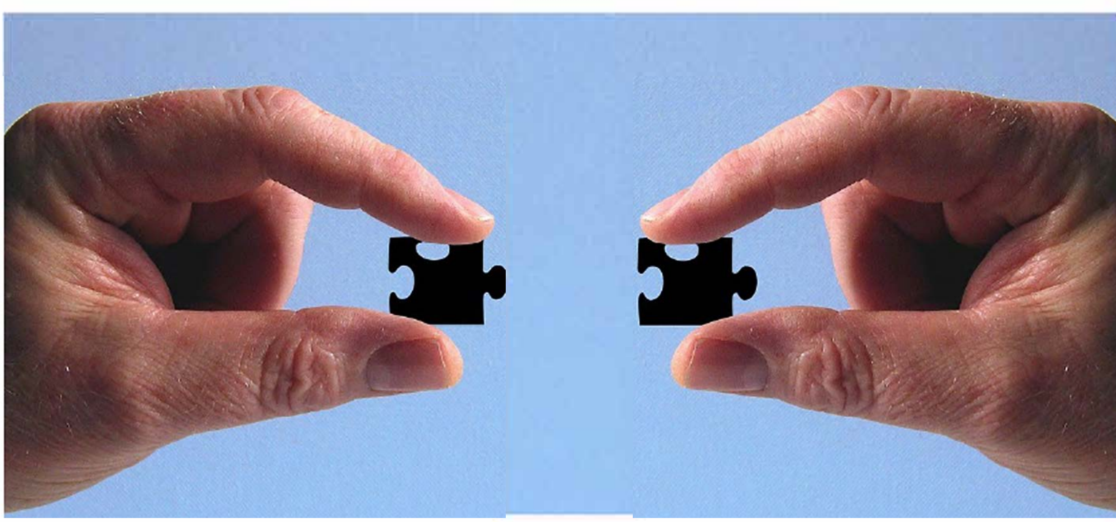
Modification Types

There are two primary types of basin modifications, scientific and jurisdictional, each with specific requirements to justify the modification request. The following is a description and graphical representation of the types of basin or subbasin modifications:

Scientific Modifications: Scientific-based modifications are those that are directly attributed to the hydrogeologic definition of the groundwater basin. These modifications require geologic and/or hydrologic evidence to support a boundary modification that will increase the likelihood of sustainable management of the groundwater basin.

Jurisdictional Modifications: Jurisdictional modifications are those which increase the likelihood of sustainable groundwater management by modification of basin boundaries to promote the implementation of the SGMA without limiting the ability of the basins or affected basins to manage groundwater sustainably. Jurisdictional modifications have three sub categories: internal, consolidation, and subdivision.

Implementation is expected to begin in January with a 90 day period for local public agencies to propose basin boundary modifications (January to March 2016). DWR plans on making decisions on basin boundary modification requests by early 2017. You can find more information on the SGMA Basin Boundary Emergency regulations on the updated Department SGMA website at http://www.buttecounty.net/waterresourceconservation/



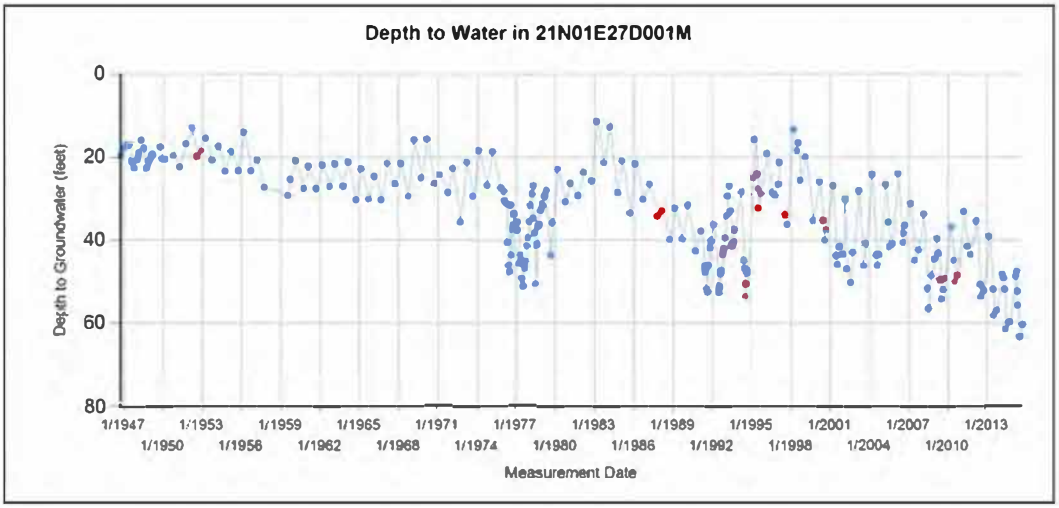
Paradise Irrigation District

According to the General Manager George Barber, "The agricultural community is really what formed the area." The District was originally formed in 1916 as an irrigation district for agriculture customers and the boundary has remained nearly unchanged for the last 100 years. The District now has 10,500 connections, of which 95% are residential and only 5% are agricultural in nature. Although the area is no longer thought of as an agricultural hot-spot, without the reliable water supply provided by the District the Paradise area would more closely resemble Forrest Ranch or Cohasset. It has really been the access to reliable water that has allowed the community to grow.

Mendon's Nursery

Jerry and Joanne Mendon first opened a fruit stand out of their home in 1974, then began selling a few saplings. Forty-one years later the business has grown to 5.5 acres and hundreds of varieties of plants. Now in the second generation their son John has taken over the day to day operations of the nursery, however, John readily admits that his dad is still the boss.

The Mendon family prides themselves in being able to help their customers find the perfect plants to flourish in their specific area. With each employee specializing in specific plants and sizes they have experts on houseplants, roses, perennials, azaleas, Japanese maples and dwarf conifers, to name a few. And, as John points out, with the mild weather in our area we are fortunate in that we can plant year round.



Fall 2015 Groundwater Conditions

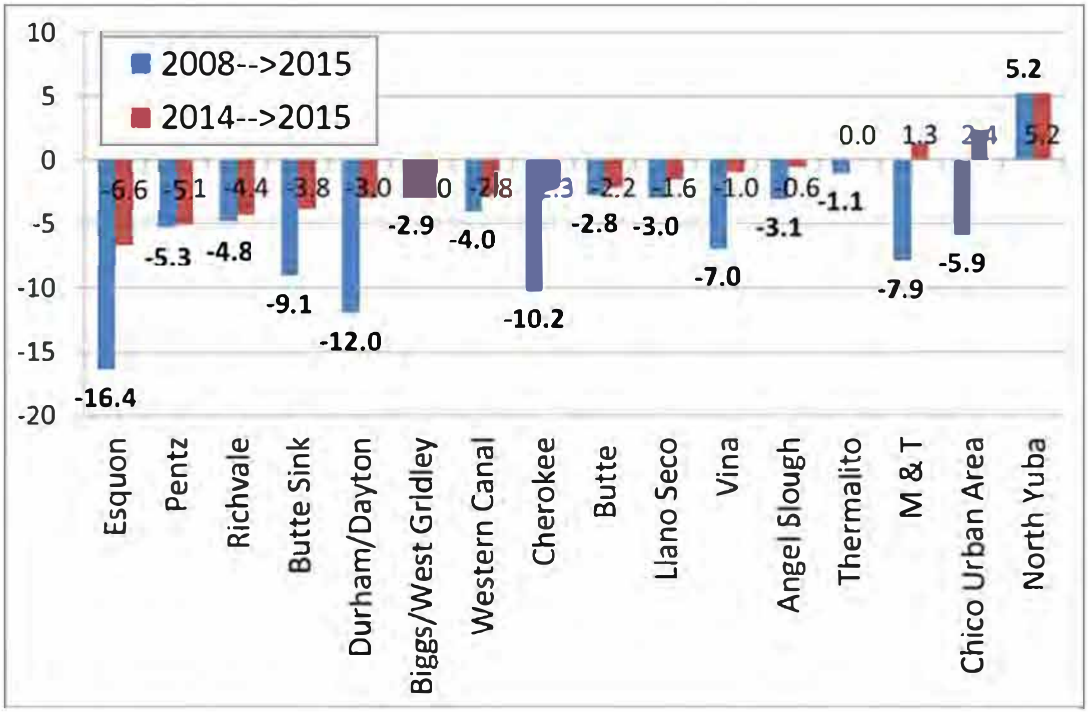
By Christina Buck

The 2015 fall groundwater level measurements in Butte County were conducted by the Department of Water Resources Northern Region Office during the week of October 12th and reviewed by the Butte County Technical and Water Advisory Committees at their combined TAC/WAC meeting November 12th. One hundred and twenty-three wells were measured throughout the valley portion of the county.

Most wells had a lower groundwater level this fall than they did last fall (88 out of 113 comparable wells) with an overall average change of negative 2 feet. Although we started off in the spring with levels in many wells that were close to spring 2014 levels, lower fall levels now compared to last year indicate that the aquifer was drawn down further this year over the course of the irrigation season. This could be due in part to higher demands or to the dry spring, a combination of the two, or other factors. Twenty-two wells saw an increase in water level ranging from 0.1 to 16 feet with a median increase of about 1 foot.

Sub-region	SWN	Well Type	Well Depth	First Record	Alert Stage
Esquon	**20N02E09L001M**	**I**	**I**	**1953**	**2**
Thermalito	18N03E21G001M	I	S	1953	1
Angel Slough	**21N01W23J001M**	**I**	**S**	**1941**	**2**
Chico Urban Area	CWSCH01	M&I	U	1988	1
	CWSCH03	M&I	U	1988	1
	CWSCH06	M&I	U	1988	1
	22N01E28J001M	**M**	**I**	**1958**	**2**
	22N01E28J003M	**M**	**I**	**1958**	**2**
	22N01E28J005M	**M**	**D**	**1958**	**2**
Durham-Dayton	**20N01E10C002M**	**I**	**S**	**1947**	**2**
	20N02E06Q001M	**I**	**S/I**	**1947**	**2**
	21N01E27D001M	**D**	**S**	**1946**	**2**
M&T	22N01E29R001M	I	I	1947	1
Vina	**22N01E20K001M**	**D**	**S**	**1961**	**2**
	23N01W27L001M	D	S	1976	1
	23N01W36P001M	**D**	**S**	**1959**	**2**

Well Type: I-Irrigation well; M&I-Municipal & Industrial well, D-Domestic well
Well Depth: S-Shallow <200 feet deep; I-Intermediate 200-600 feet deep; D-Deep >600 feet deep; U-Unknown



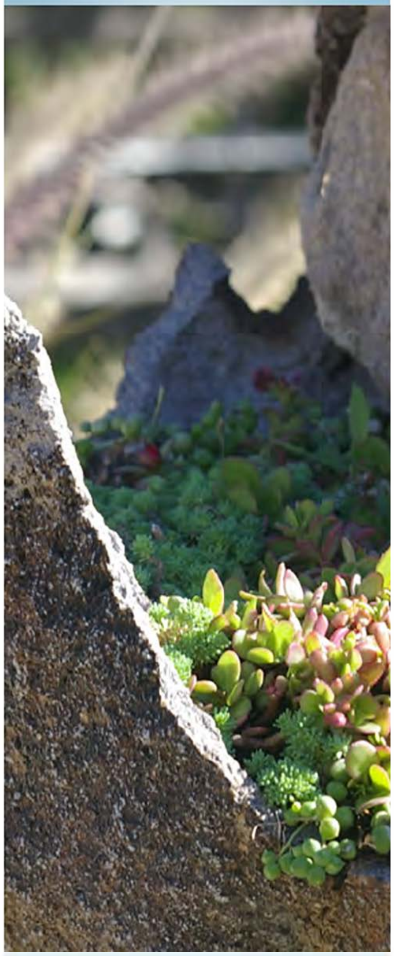
Average change in Water Surface Elevation (WSE) for Fall 2008 to Fall 2015 and for Fall 2014 to Fall 2015

Of the 88 wells that were lower than last year's fall level, the median decrease was about 2.3 feet with a range of 0 to 8 feet of decline. The biggest declines were in wells in the Esquon, Pentz, Richvale and Butte Sink areas with an average 3.8 to 6.6 feet of decline. The bar graph shows average changes in water level in wells in each subregion and compares levels in 2014 to 2015 (red bars) and in 2008 to 2015 (blue bars). Also of note is the positive average 2.4 foot increase in water levels in the Chico Urban Area. Significant reductions in demand due to conservation efforts and changed outdoor irrigation practices has had a positive impact on the aquifer in this area. Although levels are still on the low end due to dropping levels over the past several years, reduced water use this year helped to slow or reverse the declining trend in Chico. Reduced water use can and does make a difference!

GROUNDWATER CONDITIONS (page 6)>>>

Spring Valley Ranch

Established in 1977 by Mark Dunlap, DMV, and his wife Tania, Spring Valley Ranch originally started as an Arabian horse ranch and breeding facility. Over the years the ranch has grown to include breeding, boarding, training, and conditioning for all breeds of horses. The facility also offers riding lessons with four of the area's top trainers; Ricky Johnson, Kelsey Knox, Katherine Fooy, and Rhonda Lee. The trainers offer lessons in Western, English & Hunter Pleasure, Sidesaddle, Trail, Hunter Over Fences/ Jumper, Halter, and Showmanship from beginner to expert level. Although breeding is no longer the main focus of the ranch, the Dunlap's, with the assistance of Rhonda Lee, continue to offer their expertise in equine reproduction, phantom training, and broodmare management.



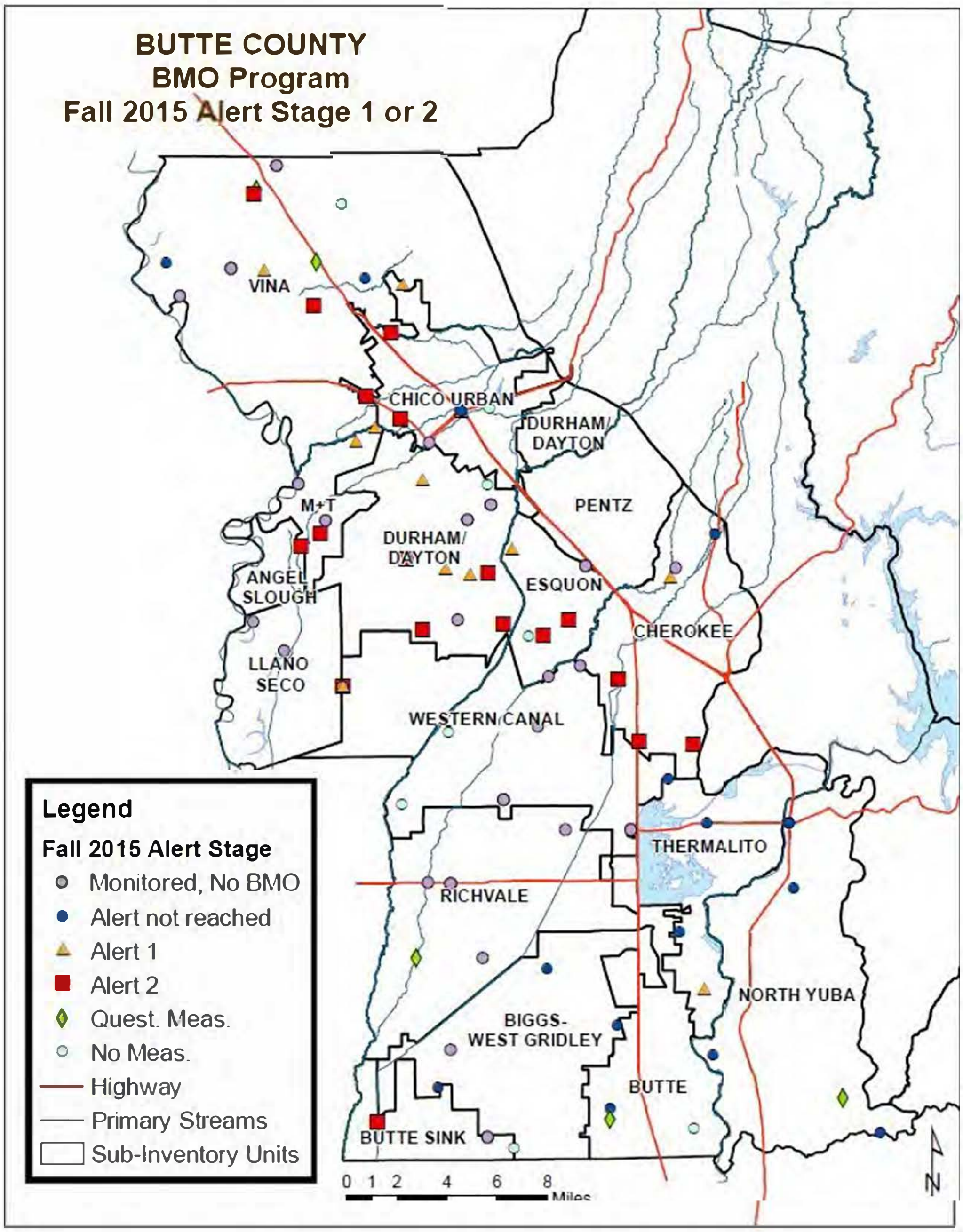
Butte College Agriculture

Butte College has an extensive Agriculture department including over 550 acres of wildlife refuge, 2 miles of riparian habitat along Clear Creek, an extensive environmental horticulture greenhouse facility and farming of 85 acres of vineyard, fruit orchards, and hay. The College currently offers 577 agriculture majors and six academic programs: Ag Science, Ag Business, Pest Control Advisor, Environmental Horticulture, Mechanized Ag, and the Heavy Equipment Operator Technician Certificate Program.

While visiting the campus we were introduced to Alice Dupree, Horticulture Club President, who said that she truly feels that she is learning more than just how to run a business, this is an excellent opportunity to learn leadership, networking, and gain the lifelong connections that are so important in the success of the agriculture community.

The Fall Alert Stage Map shows the locations of monitoring wells that are in either a stage 1 or stage 2 alert level. This indicates that levels in these wells are near or below their previously recorded low. Since many of these wells began to be monitored in the late 1990s/ early 2000s, this is the first drought we've observed with them so it is not surprising that they are reaching historical lows compared to their short history. For greater historical context, there are 16 wells that have records dating back to 1988 or earlier that are an alert stage one (6 wells) or two (10 wells). These wells are located in the Vina, Chico, M&T, Durham-Dayton, Angel Slough, Esquon, and Thermalito areas (roughly from north to south). Looking at the water level trends in these wells in light of changing hydrologic and water demand conditions over the past several decades provides a greater historical context for the groundwater conditions we're currently experiencing. The table lists these wells by area and state well number. Data and graphs for each of these wells can be viewed online from the State's Water Data Library (http://www.water.ca.gov/ waterdatalibrary). A graph of depth to water level in a shallow domestic well in the Durham area is included as an example (21N01E27D001). The greatest declines have been observed in and around the Durham-Dayton area over the past several years.

A summary of the fall data will be presented at the December Water Commission meeting. Call Christina Buck to discuss or with any questions, 538-6265.



CALIFORNIA WATER FIX

RELIABLE. CLEAN. WATER.

Butte County Opposes the California WaterFix Project

By: Paul Gosselin

On October 28, 2015 the Butte County Board of Supervisors formally declared its opposition to the California WaterFix project. The California WaterFix project is a component of what was previously the Bay Delta Conservation Plan (BDCP). For the past eight years, state and federal agencies have been pursuing the development of the BDCP. On April 30, 2015, state and federal officials announced that the BDCP process would be replaced by the "California WaterFix" and "California EcoRestore" projects. The California EcoRestore project seeks to restore more than 30,000 acres of fish and wildlife habitat over the next three to four years. The California WaterFix project is focused on water conveyance actions that include the construction of two water conveyance tunnels. In July 2015, state and federal agencies recirculated their draft Environmental Impact Report/Supplemental Environmental Impact Statement (EIR/EIS) on the California WaterFix project for public comment. The comment period ended on October 30, 2015. Additionally, the Department of Water Resources applied for a California WaterFix contraction permit with the U.S. Army Corps of Engineers. The permit would authorize the construction of the conveyance tunnels. The comment period on California WaterFix construction permit ended on November 9, 2015. The Butte County Board of Supervisors sent a letter to the U.S. Army Corps requesting that they reject the construction permit based on the County's concerns with the California WaterFix.

Butte County has actively engaged in the BDCP process and offered constructive recommendations over the course of its development. On August 14, 2012, the Butte County Board of Supervisors adopted the Resolution Opposing the BDCP (12-096) based on the failure to address concerns previously raised by the county. The California WaterFix project and its associated EIR/EIS remain essentially unchanged and fails to address the concerns of Butte County. The failure of the California WaterFix are more than legal technicalities, it could lead to actions that will damage the region's economy, environment and communities. The impacts from the California WaterFix are numerous. One major concern is that the California WaterFix project proposes to increase in groundwater use in the Sacramento Valley to make up for shortfalls in surface water supply of south of the Delta water contractors. The resulting impacts to groundwater basins in the northern Sacramento Valley region could have devastating consequences. Another impact involves the depletion and, in some instances, draw down of upstream reservoirs to dead pool conditions. The result would impact the local economy and prevent other water users from obtaining supplies to which they are entitled under legal contract or water rights. Contrary to state and federal commitments, implementation of the California WaterFix will result in adverse effects on the water rights of those in the watershed of the Delta, and would impose obligations on water users upstream of the Delta to supplement flows in and through the Delta. The California WaterFix project will not solve the water supply reliability problems, will be detrimental to the environment, will redirect impacts to the northern Sacramento Valley region and fails to assess the environmental and socioeconomic impacts. Despite failing to address these concerns, California WaterFix is proceeding forward. In 2016 the State Water Resources Control Board will begin the process of considering the water right petition and water quality certification process for the California WaterFix project. The Butte County Board of Supervisors remains opposed to the California WaterFix project. For more information on the California WaterFix project and the County's opposition, please visit the department's webpage under Programs/Delta Issues/BDCP

http://www.buttecounty.net/waterresourceconservation/BayDeltaConservationPlan.aspx

Noble Orchards

Purchased in 1921 by Grandpa Noble, Noble Orchards is the last original apple orchard on the ridge. Built in the 20's and 30's, the orchard was once the largest apple farm and egg production ranch in Butte County. The orchard is substantially smaller now, but still has 31 separate varieties of apples "even if it is only one tree", our host joked. Visiting the orchard now feels as if you had stepped back in time. The packing shed, built by Grandpa Noble in the 30's, is used as an open market where the shaded area naturally keeps the apples, sauce and cider cool. , the Orchard is open 7 days a week during peak season, closing only on Thanksgiving, Christmas, and New Year's Day.

It was just after noon when we loaded the bus and headed back toward Chico. As Richard and Lee discussed how the drought was affecting agriculture and Richard answered a few questions about people's wells going dry, I realized that I was still wearing my scarf. Cooler days are officially here, let us pray that rain follows soon after.

Meeting Schedules

Water Commission

12/2/2015, 1:30 p.m.
Board of Supervisors Chambers
25 County Center Drive

Board of Supervisors

12/6/2015, 9:00 a.m.
Board of Supervisors Chambers

Drought Task Force

12/7/2015, 2:00 p.m.
Training Room
3 County Center Drive

Department of Water & Resource Conservation

308 Nelson Avenue
Oroville, CA 95965

Phone: 530.538.4343
Fax: 530.538.3807
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bcwater@buttecounty.net
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Water & Resource Conservation Staff

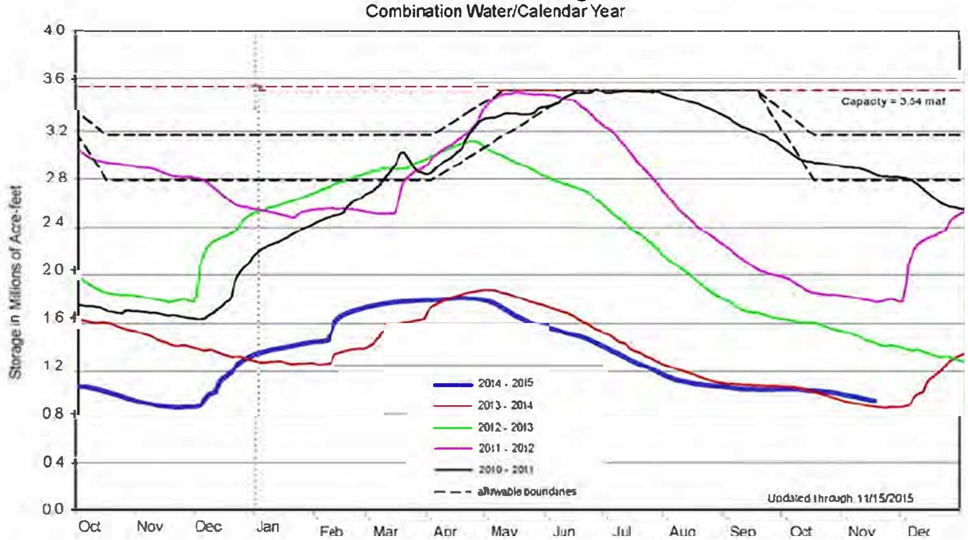
- Paul Gosselin, Director
- Vickie Newlin, Assistant Director
- Christina Buck, Water Resource Scientist
- Autum Kirk, Administrative Assistant , Senior

Water Commission

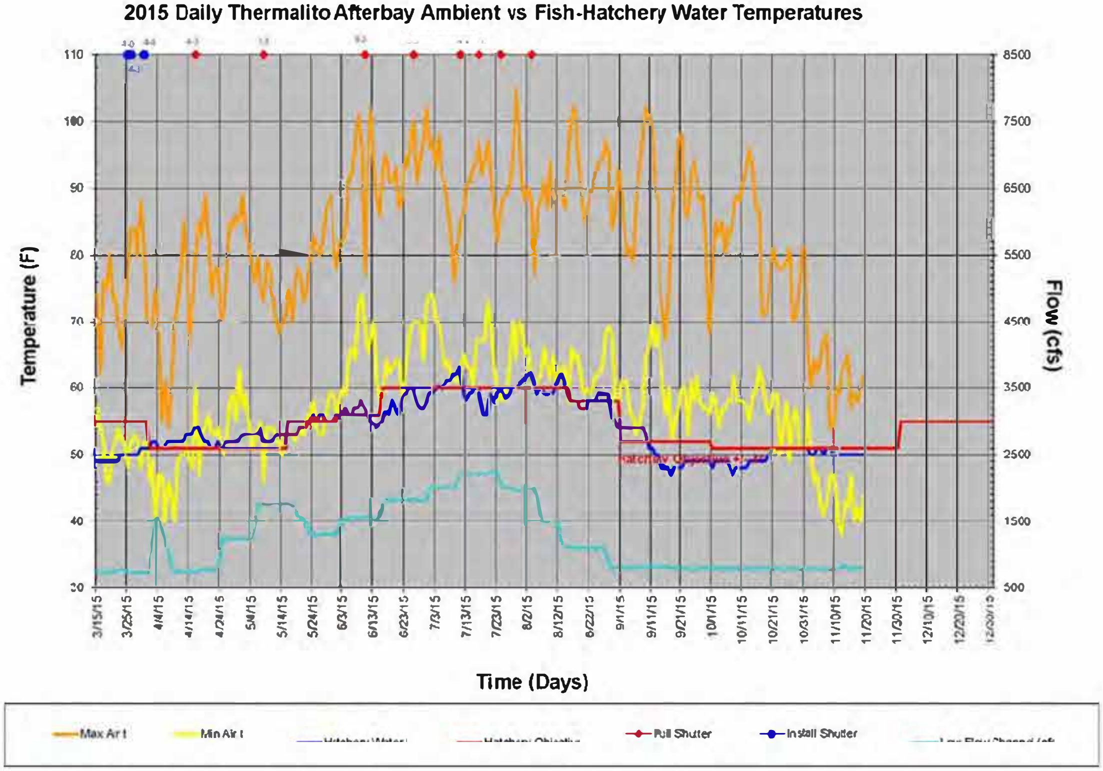
- Tony Archuleta
- George Barber, Chair
- DC Jones, Vice-Chair
- Kathy Chance
- Brad Mattson
- Ryan Schohr
- John Scott
- David Skinner
- Ernie Washington

Butte County
WATER & RESOURCE CONSERVATION

Lake Oroville Storage
Combination Water/Calendar Year



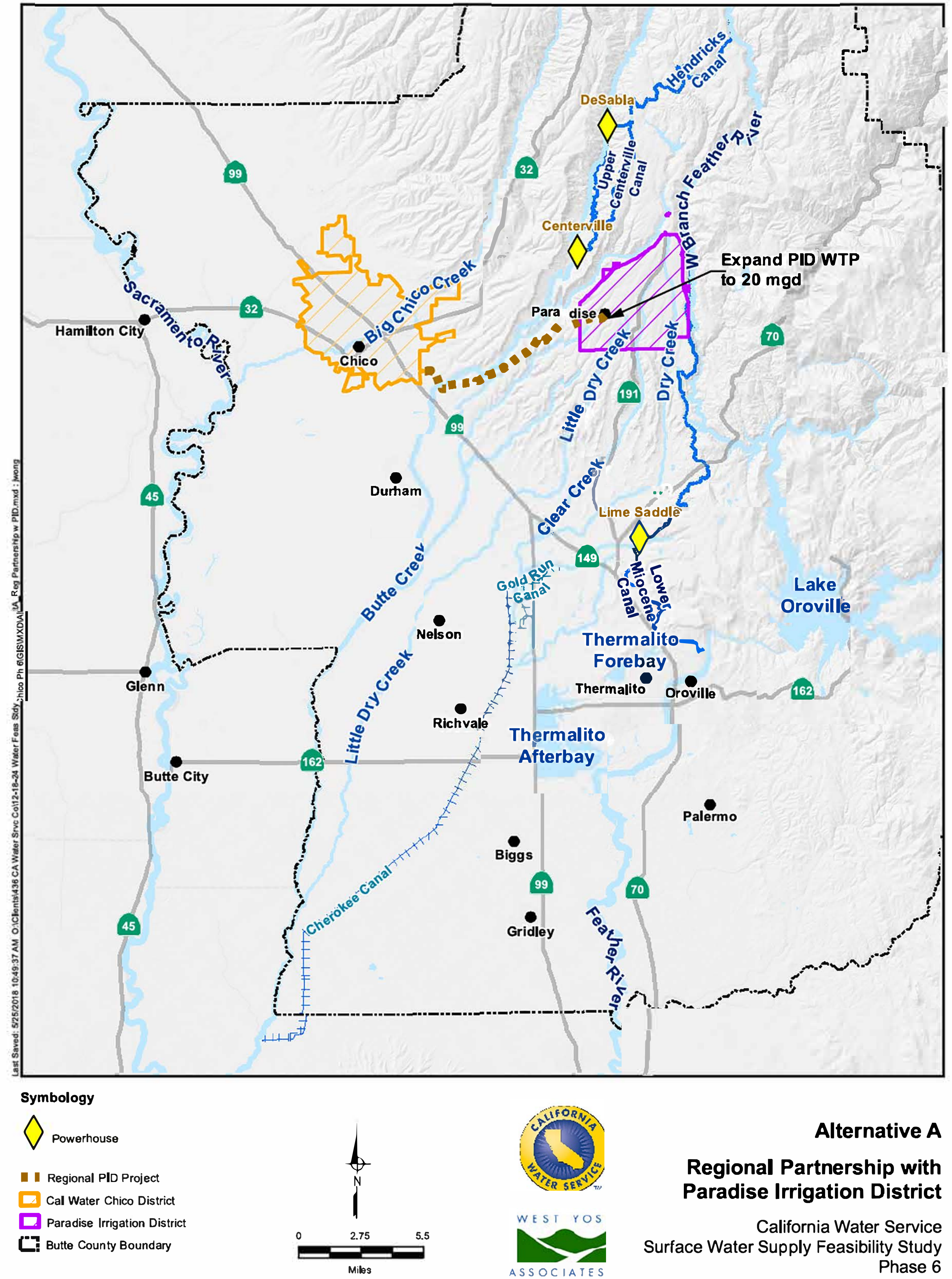
2015 Daily Thermalito Afterbay Ambient vs Fish-Hatchery Water Temperatures



ATTACHMENT C

Project Information Sheets for Preliminary Screening

Alternative A. Regional Partnership with Paradise Irrigation District (PID)	
Criteria	**Description**
Concept Description	• Deliver water from the Upper Miocene Canal to PID Water Treatment Plant via existing facilities • Expand PID WTP from 16 mgd to 20 mgd and use available capacity to treat water for delivery to Cal Water. • Deliver up to 8 to 10 mgd via 10 miles of 24-inch diameter transmission main to Chico District during normal and wet years • Possibly partner with City of Chico to include wastewater delivery
Cost	• Not yet developed
Key Issues	• From a water rights perspective, Table A water is assumed to be water that has already reached the Lake Oroville. Use of water upstream of Lake Oroville would require a significantly narrower operating window, when PG&E, the primary water rights holder would not be affected, or use PID's or other water rights. • Project would be more attractive to PID/Town of Paradise if wastewater delivery to Chico could be incorporated into the project
Questions to Address	• Is PID still interested in pursuing this concept? • Would/could PID or other water rights be used? • If PID water is unavailable, is there any other water that could be used for project? • Is partnering with City of Chico to include wastewater delivery still on the table?
Information Needed to Develop/Assess Concept	• Information from PID on timing/availability of raw water conveyance and WTP capacity • Information from PID on existing WTP processes, concept-level information on expansion details, expansion costs, water costs, etc., if available • Meeting with PID to review concepts and available information
Information sources: PID Meeting to gather information (July 6, 2016).	



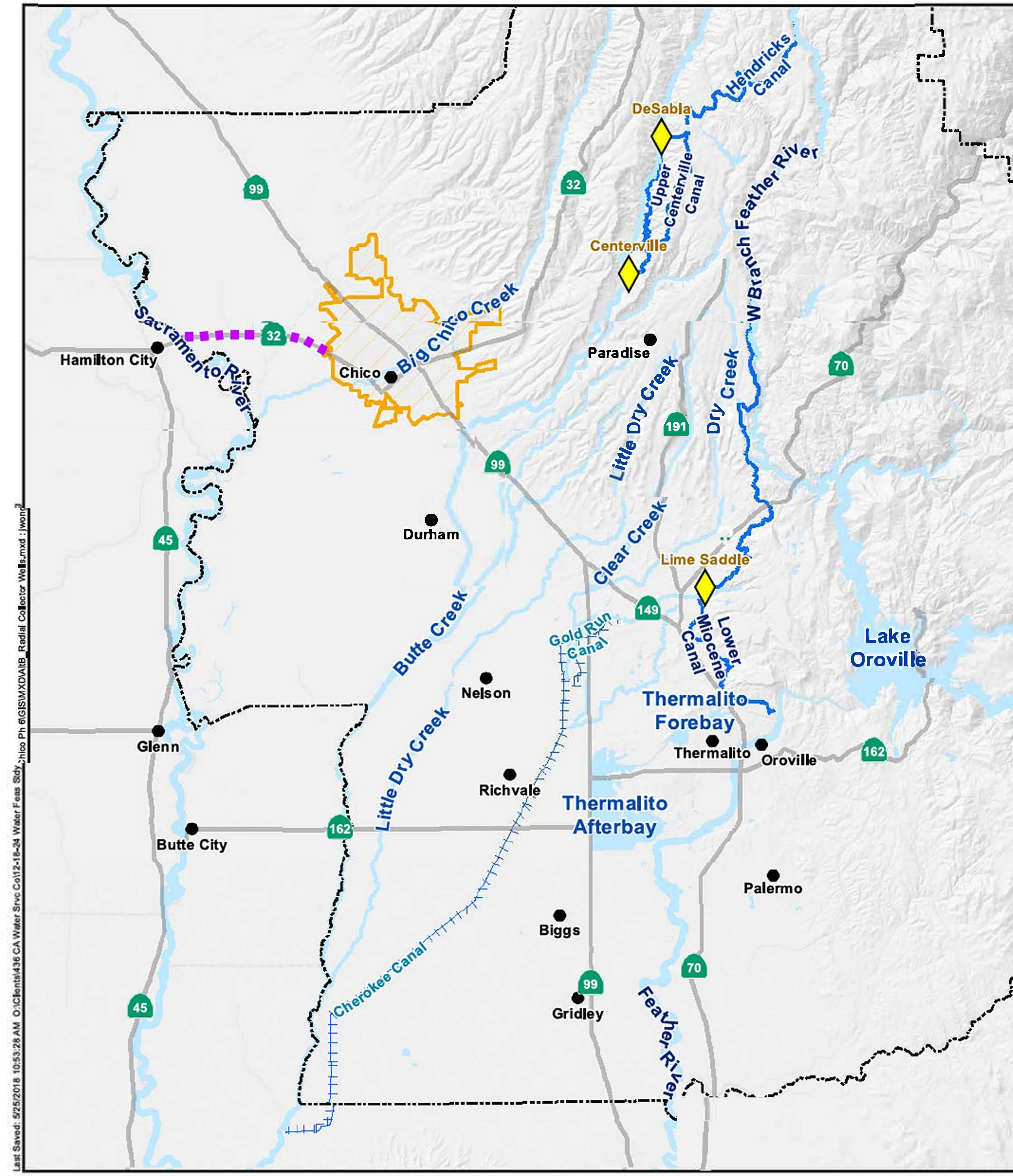
Alternative A

Regional Partnership with Paradise Irrigation District

California Water Service
Surface Water Supply Feasibility Study
Phase 6

Alternative B. Radial Collector Wells along the Sacramento River	
Criteria	**Description**
Concept Description	• Install two radial wells adjacent to Sacramento River, 9 mgd each, 18 mgd total, and 31,000 feet of 42-inch diameter pipeline along Hwy 32, from wells to Chico District, to new WTP. • Estimated long-term average delivery between 10,500 and 11,700 AFY, based on long-term planning studies from the 2009 State Water Project Delivery Report. Does not take into account delivery restrictions that U.S. Bureau of Reclamation (Reclamation) would impose.
Cost	• Capital Cost: $32M for wells and pipelines (12/2017 dollars), ballpark cost for WTP $84M ($3/gallon construction cost for 18 mgd plant, 1.56 multiplier for capital costs) for total cost of $116M. • Annual Cost: $21M (Revenue Requirement, 13%; O&M, 5%; Energy, $0.14/kwh for radial wells (energy cost for WTP not estimated))
Key Issues	• Coordinated agreement would be used to exchange CVP/SWP water by Reclamation releasing water from Lake Shasta for diversion to project, and DWR releasing same quantity of water from Lake Oroville. • Although diversions from the Sacramento River are possible under the CVP/SWP Coordinated Agreement, Reclamation will not allow diversions that would reduce the cold-water pool at Lake Shasta that is used to meet temperature requirements in the Sacramento River. Affected years would be years following multiple dry years. Temperature modeling would be required to estimate the impact of this issue. • Even if Cal Water participation in Sites could be used for water augmentation for temp control, still have approx. 30 miles of river (Hwy 32 to Maxwell Rd, assumed Sites River tie-in) that would be impacted. • CalTrans does not allow longitudinal easements. Would require private easements for pipeline.
Questions	• Is it possible to develop this alternative with groundwater recharge option rather than treatment? For discussion on 6/8.
Information Needed to Develop/Assess Concept	• Analysis of options without WTP

Information sources:
West Yost Associates, 2012, Summary of Surface Water Delivery Estimate and Evaluation of Preliminary Surface Water Conveyance Projects
West Yost Associates, 2013, Preliminary Alignment Study



Symbology
- Powerhouse
- Raw Water Transmission Pipeline
- Cal Water Chico District
- Butte County Boundary

Alternative B

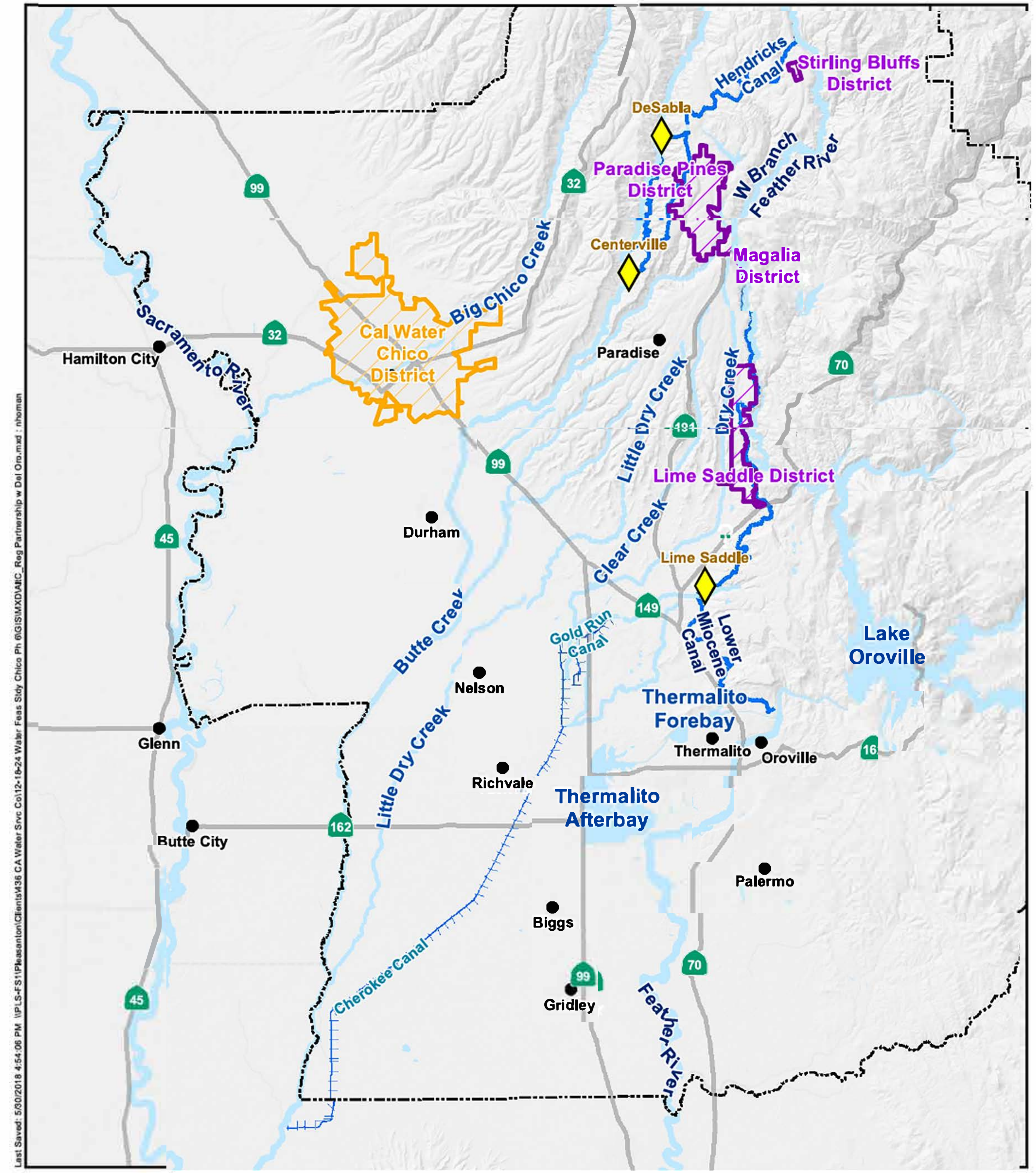
Radial Collector Wells along the Sacramento River

California Water Service
Surface Water Supply Feasibility Study
Phase 6

Alternative C. Regional Partnership with Del Oro Water Company, Lime Saddle District

Criteria	Description
Concept Description	Concept not yet defined. Information on Del Oro Water Company, Lime Saddle District • 351 connections, population 1310 • Lime Saddle WTP, two active wells • Public water system 0405001 • Odor problems in 2014-2016. Considered GAC system for $400K, but did not implement because meeting MCL for odor.
Cost	• Not yet developed
Key Issues	• Per Vickie, this agency is water short. Could use Table A water to improve their supply as part of this project? • Del Oro Water Company also privately held regulated utility, so no opportunity for grant funding unless broader partnership.
Questions to Address	• Is a regional partnership with another private utility prudent? • Is there sufficient WTP capacity/space to consider project? • Is Del Oro Water Company interested in partnership?
Information Needed to Develop/Assess Concept	• Possible routes for delivery of water to Chico • Discuss with Del Oro Water Company, if wanting to pursue

Information Sources:
California Drinking Water Watch, information on public water systems
https://sdwis.waterboards.ca.gov/PDWW/JSP/WaterSystemDetail.jsp?tinwsys_is_number=90&tinwsys_st_code=CA&wsnumber=CA0405001
Del Oro Water Company, Proposed Treatment Informational Update
http://www.delorowater.com/deloro/images/files/districts/limesaddle/Lime%20Saddle%20update%20notice%209-28-16.pdf



Symbology
Powerhouse
Cal Water Chico District
Del Oro Water Company
Butte County

0 2.75 5.5
Miles

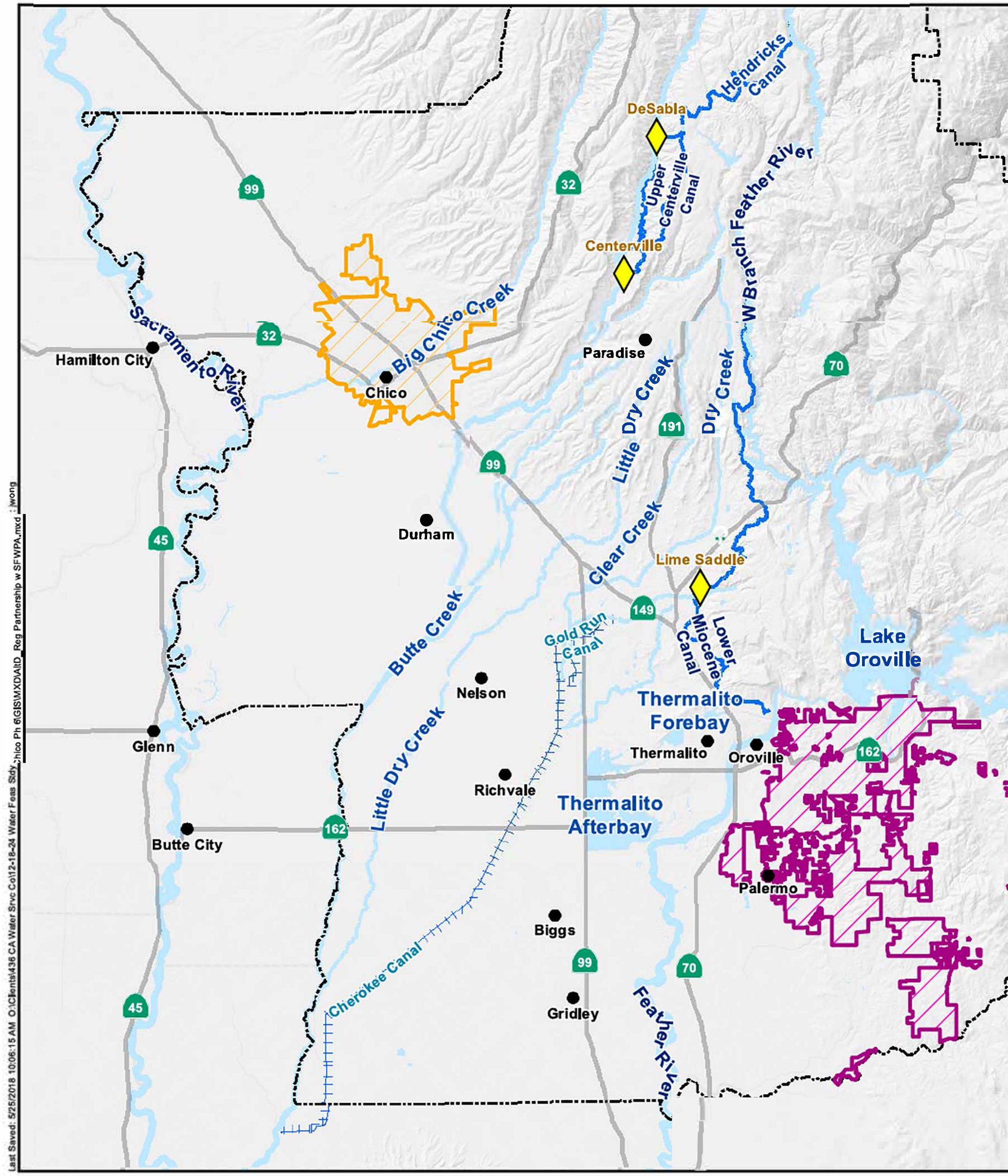
Alternative C

Regional Partnership with Del Oro Water Company

California Water Service
Surface Water Supply Feasibility Study
Phase 6

Alternative D. Regional Partnership with South Feather Water and Power Agency	
Criteria	**Description**
Concept Description	• Purchase excess water from South Feather Water and Power Agency and convey water to Chico District via open channel, pipeline or combination of open channel and pipeline. Pipeline/channel alignment to Chico District would be same/similar to Oro Chico Conduit, and/or Sac Northern Railroad. • South Feather's Kelly Ridge Powerhouse discharges into the Feather River just downstream of Lake Oroville, upstream of Thermalito Forebay. Kelly Ridge power tunnel capable of conveying up to 260 cfs flow. South Feather has pre-1914 water rights.
Cost	• Not yet developed
Key Issues	• No information yet on possible concept, and willingness of Agency to partner with Cal Water. • FERC re-licensing application filed in 2007. DEIS published in 2008. Final EIR in 2009. NMFS working on Biological Opinion. 2012 settlement agreement with DWR, requesting South Feather to temporarily discharge to Lake Oroville rather than thru Kelly Ridge Powerhouse, to help DWR meet temperature standards. • Temperature issues identified in DEIS that affect fish hatchery facilities. Alternatives looked at management of project for temperature control.
Questions to Address	• Is South Feather Water and Power interested in pursuing this concept? • What information does the Agency have to help us flesh this out? Water and power studies? Other? • What is status of FERC re-licensing? • Status of DWR 'temporary' settlement agreement and how does that impact this alternative?
Information Needed to Develop/Assess Concept	• Discussion with South Feather, if want to pursue

Information sources:
Draft EIR, South Feather Power Project, 2008
https://sdwis.waterboards.ca.gov/PDWW/JSP/WaterSystemDetail.jsp?tinwsys_is_number=90&tinwsys_st_code=CA&wsnumber=CA0405001
NOAA Fisheries, South Feather Hydroelectric Project
http://www.westcoast.fisheries.noaa.gov/fish_passage/ferc_licensing/feather_river/south_feather.html
State Water Resources Control Board. Information on Project re-licensing
https://www.waterboards.ca.gov/waterrights/water_issues/programs/water_quality_cert/southfeather_ferc2088.shtml



Symbology
Powerhouse
Cal Water Chico District
South Feather Water and Power Agency
Butte County

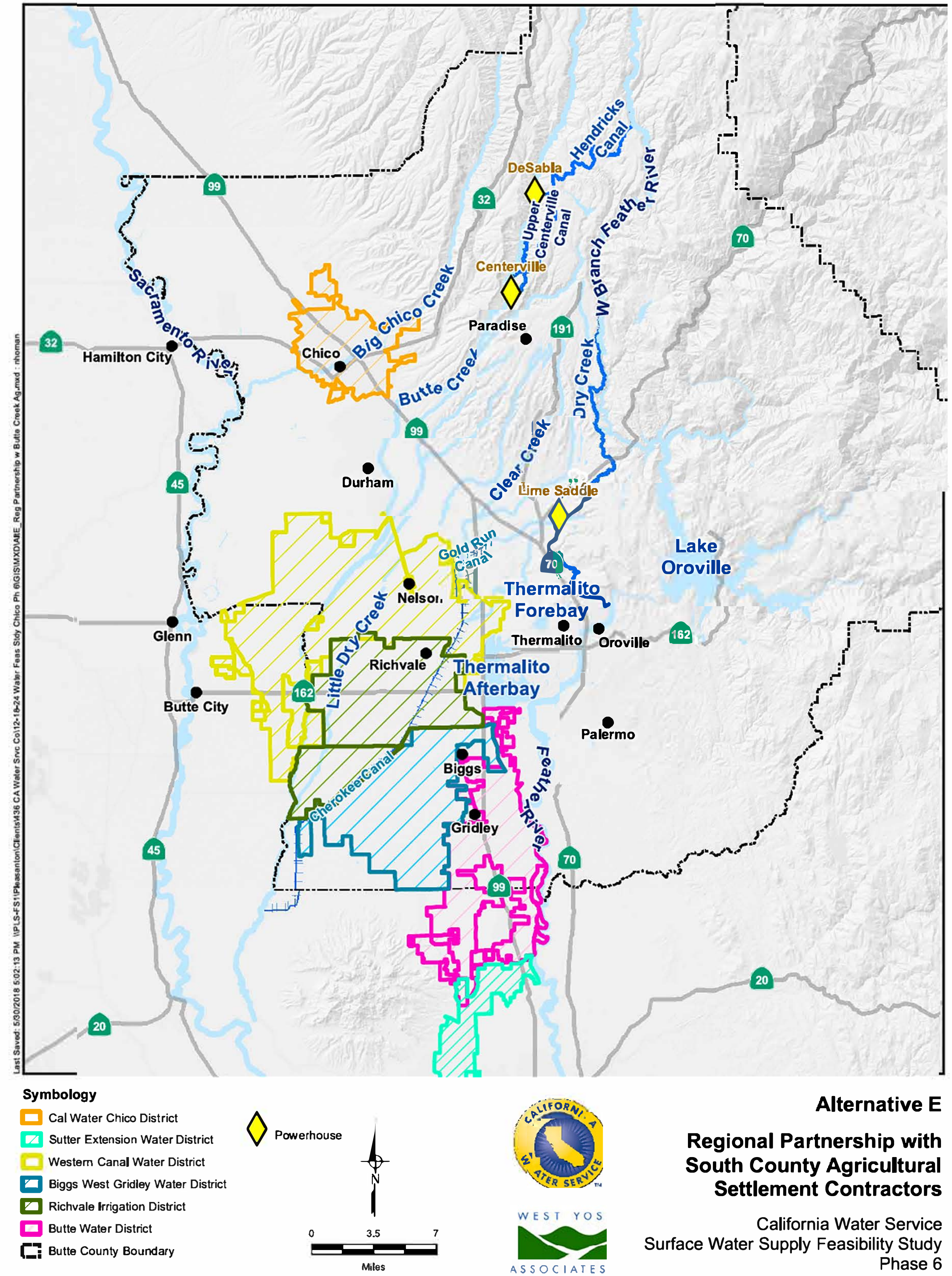
0 2.75 5.5
Miles

Alternative D

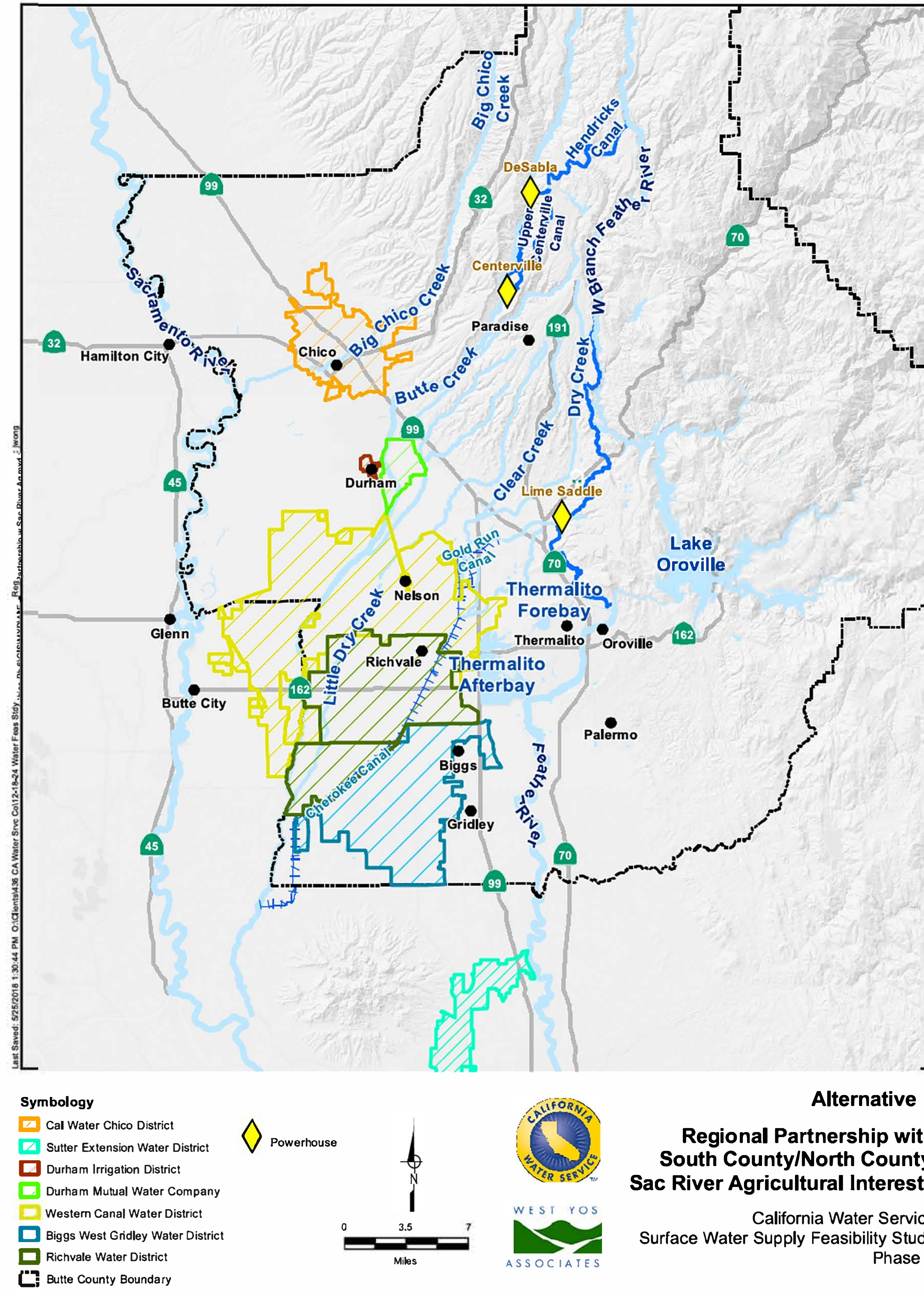
Regional Partnership with South Feather Water and Power Agency

California Water Service
Surface Water Supply Feasibility Study
Phase 6

Alternative E. Regional Partnership with South County Agricultural Settlement Contractors	
Criteria	**Description**
Concept Description	• Purchase surplus water available in normal and wet years from South County Agricultural Settlement Contractors. Concept would be paired with Oro-Chico conduit or pipeline or canal conveyance options from Thermalito Afterbay to convey water to Chico District. Background Info: Agricultural Settlement Contractors are southern Butte County water agencies with pre-1914 water rights, who entered into settlement agreements with Department of Water Resources that acknowledge their prior rights and specify how water will be delivered to agencies. Western Canal Water District (WCWD) has pre-1914 water rights from West Branch Feather, and entered into a settlement agreement in 1986 with DWR for delivery to Western Canal from Thermalito Afterbay (150,000 AF natural flow, subject to reduction during droughts; 145,000 AF storage in upstream reservoirs, not subject to drought reduction). Richvale Irrigation District (RID), Biggs West Gridley Water District (BWGWD), Butte Water District (BWD) and Sutter Extension Water District (SEWD) organized to form the Joint Water Districts Board, to coordinate efforts in managing the Sutter Butte Canal Company distribution system, that they share. Joint Districts have pre-1914 rights and entered into a settlement agreement with DWR in 1969 for diversion of up to 555,000 AF, subject to reduction during droughts, based on their pre-1914 rights, from Feather River, taken at Thermalito Afterbay.
Cost	• Not yet developed
Key Issues	• Not yet identified
Questions to Address	• Interest of South County Agricultural Settlement Contractors? • Water availability and timing?
Information Needed to Develop/Assess Concept	• Discussion with South County Agricultural Settlement Contractors to discuss interest, water quantities, etc. • Vickie Newlin to investigate potential SGMA link for agricultural users.
Information sources: Feather River Regional Ag Water Management Plan https://www.water.ca.gov/LegacyFiles/wateruseefficiency/sb7/docs/2014/SBX%207-7%20Plans/Feather_River/FRRAWMP_Volume_I_August_2014.pdf	



Alternative F. Regional Partnership with Agricultural Groundwater Users of Butte County	
Criteria	**Description**
Concept Description	• Partner with the organization, Agricultural Groundwater Users of Butte County, a 501 (c)(6) organization comprised of groundwater users within the County that aren't customers of public water agencies. Partnership would be in conjunction with another concept to provide water to additional partners.
Cost	• Not yet developed
Key Issues	• Not yet identified
Questions to Address	• How organized/formal is this group?
Information Needed to Develop/Assess Concept	• Discussion with the group or individual members on opportunities to partner.
Information sources: Discussions with Vickie Newlin.	



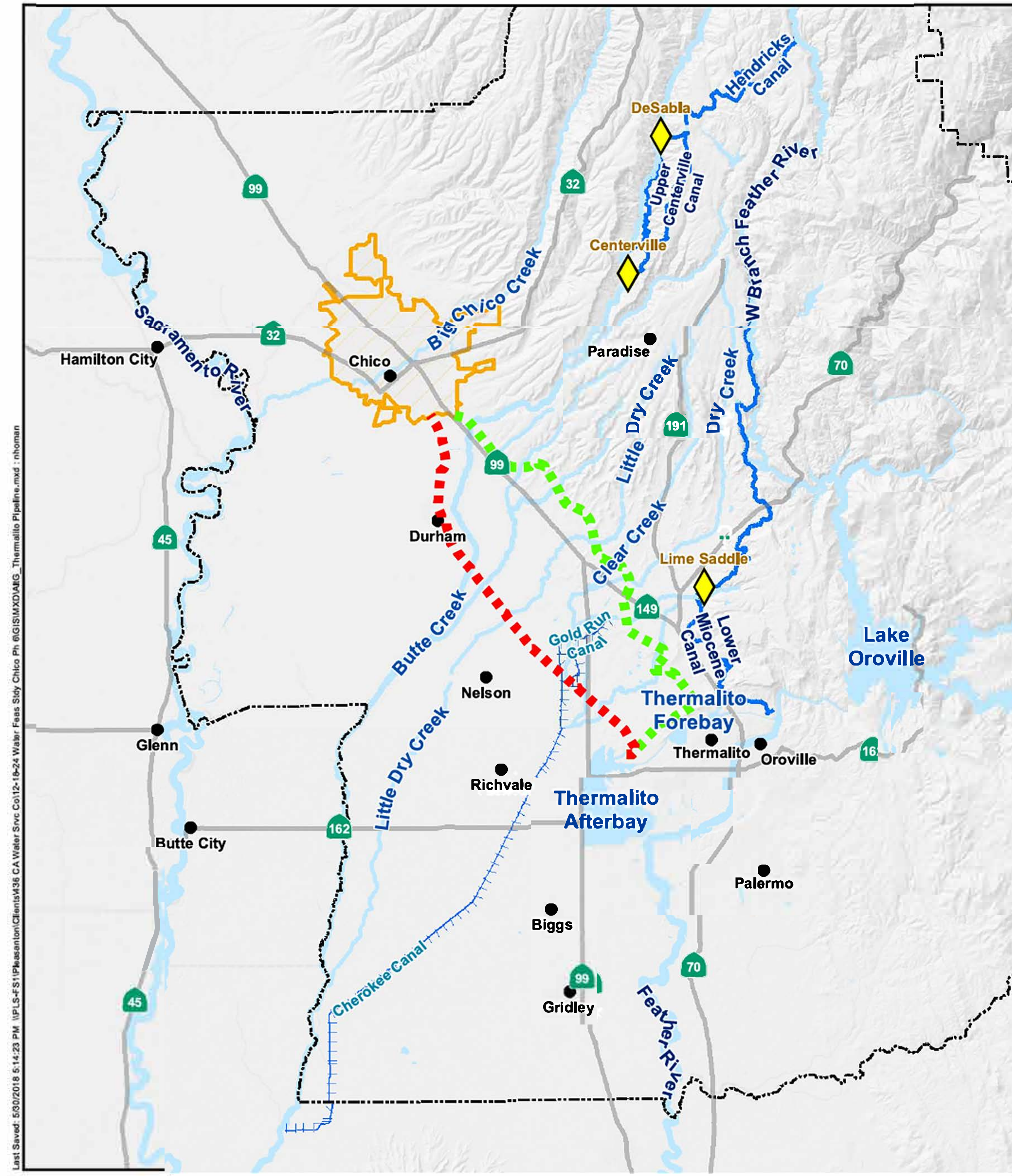
Alternative F

Regional Partnership with South County/North County, Sac River Agricultural Interests

California Water Service
Surface Water Supply Feasibility Study
Phase 6

Alternative G. Pipeline Conveyance from Thermalito Afterbay to Chico District	
Criteria	**Description**
Concept Description	• Construct pipeline from Thermalito Afterbay to Chico District. Pipeline options identified in Phase 1 of this study were 1) 101,000 ft (19 miles) of transmission pipeline along the Oro-Chico Conduit alignment, and 95,000 ft (18 miles) of transmission pipeline along the former Sacramento Northern Railroad Alignment. Pipelines were sized at 42-inch diameter to convey 18 mgd. In Phase 2 of this study, an alignment evaluation was performed for the former Sacramento Northern Railroad alignment. • Project could be paired with water supply from South Feather Water and Power Agency, South Butte County Agricultural Settlement Contractors or Table A water. • Project could also be paired with potential recharge projects/partners along the pipeline alignment.
Cost	• Pipeline: $73M in 2012 dollars • WTP estimated at $84M ($3/gallon construction, 1.56 implementation multiplier) • Total cost of $157M if treatment required • Annualized cost ~ $20M/year
Key Issues	• Expensive
Questions to Address	• Can project be re-conceptualized to deliver untreated water to Chico District and/or other recharge areas along the alignment? Evaluate how project relates to other recharge projects being considered in the County and SGMA compliance
Information Needed to Develop/Assess Concept	• Further refinement and definition required

Information sources:
West Yost Associates, 2012, Summary of Surface Water Delivery Estimate and Evaluation of Preliminary Surface Water Conveyance Projects
West Yost Associates, 2013, Preliminary Alignment Study



Symbology
Powerhouse
Sac Northern Railroad Alignment
Oro-Chico Conduit: Pipeline
State Highway
Cal Water Chico District
Butte County

N
0 2.75 5.5
Miles

WEST YOST ASSOCIATES

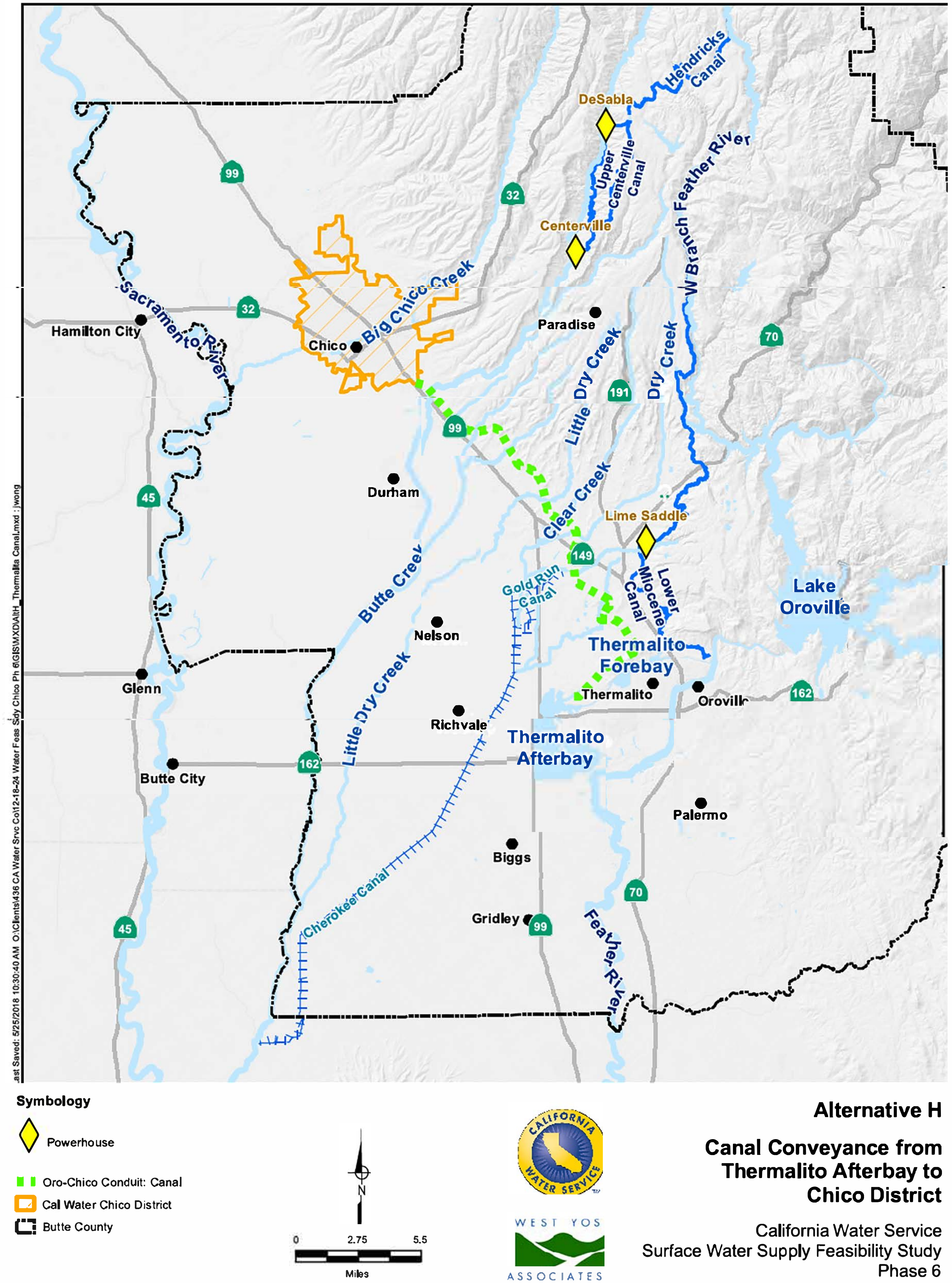
Alternative G

Pipeline Conveyance from Thermalito Afterbay to Chico District

California Water Service
Surface Water Supply Feasibility Study
Phase 6

Alternative H. Canal Conveyance from Thermalito Afterbay to Chico District	
Criteria	**Description**
Concept Description	• Construct canal from Thermalito Afterbay to Chico District along the former Oro-Chico Conduit alignment. • Canal options were evaluated in Phase 1 of this study, based on information drawn from the DWR Oro-Chico Conduit Study. Options were screened out due to conveyance losses, potential for contamination, maintenance costs. Concept should be re-visited as raw water supply/recharge project. • Project could be paired with water supply from South Feather Water and Power Agency, South County Agricultural Settlement Contractors or Table A water. • Project could also be paired with potential recharge projects/partners along the pipeline alignment, such as Alternative 1: Bi-Directional Conveyance, Alternative 2: South to North Conveyance from Oroville, or Alt 3: Construction of Recharge Basins, in the Butte County Recharge Study (GEI, 2018).
Cost	• Alt 1A: Bi-directional conveyance to Robber's Gulch- $137M in 2017 dollars; Alt 1B: Bi-directional conveyance to Hamlin Slough $112M; Alt 2A: South to North Canal $61M (GEI, 2018)
Key Issues	• Expensive
Questions to Address	• Can project be re-conceptualized to deliver untreated water to Chico and/or other recharge areas along the alignment? • Evaluate how project relates to other recharge projects being considered in the County.
Information Needed to Develop/Assess Concept	• Further refinement and definition required. Re-visit Oro-Chico Conduit Study. • Consolidate with Alternative I (Canal and Pipeline from Thermalito Afterbay to Chico District) • Evaluate how project relates to other recharge projects being considered in the County and SGMA compliance

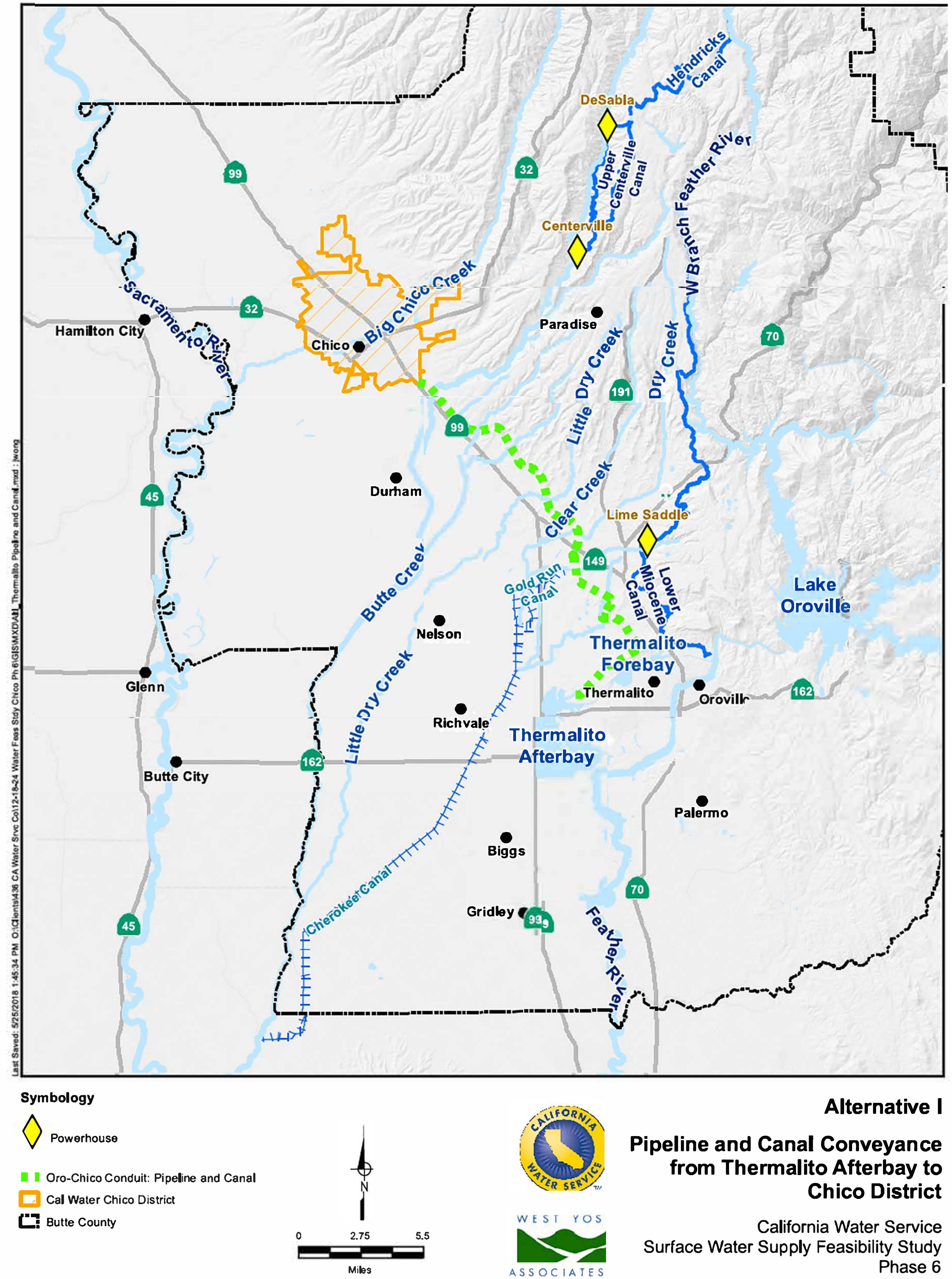
Information sources:
West Yost Associates, 2012, Summary of Surface Water Delivery Estimate and Evaluation of Preliminary Surface Water Conveyance Projects
GEI, 2018, Evaluation of Restoration and Recharge within Butte County Groundwater Basins



Alternative I. Canal and Pipeline Conveyance from Thermalito Afterbay to Chico District

Criteria	Description
Concept Description	• Construct canal and pipeline from Thermalito Afterbay to Chico District along the former Oro-Chico Conduit alignment. • Pipeline/canal options were evaluated in Phase 1 of this study, based on information drawn from the DWR Oro-Chico Conduit Study. Options were screened out due to conveyance losses, potential for contamination, maintenance costs. Concept should be re-visited as raw water supply/recharge project. • Project could be paired with water supply from South Feather Water and Power Agency, South County Agricultural Settlement Contractors or Table A water. • Project could also be paired with potential recharge projects/partners along the pipeline alignment, such as Alternative 1: Bi-Directional Conveyance, Alternative 2: South to North Conveyance from Oroville, or Alt 3: Construction of Recharge Basins, in the Butte County Recharge Study (GEI, 2018).
Cost	• Alt 1A: Bi-directional conveyance to Robber's Gulch- $137M in 2017 dollars; Alt 1B: Bi-directional conveyance to Hamlin Slough $112M; Alt 2A: South to North Canal $61M (GEI, 2018)
Key Issues	• Expensive
Questions to Address	• Can project be re-conceptualized to deliver untreated water to Chico and/or other recharge areas along the alignment? • Evaluate how project relates to other recharge projects being considered in the County
Information Needed to Develop/Assess Concept	• Further refinement and definition required. Re-visit Oro-Chico Conduit Study.

Information sources:
West Yost Associates, 2012, Summary of Surface Water Delivery Estimate and Evaluation of Preliminary Surface Water Conveyance Projects
GEI, 2018, Evaluation of Restoration and Recharge within Butte County Groundwater Basins

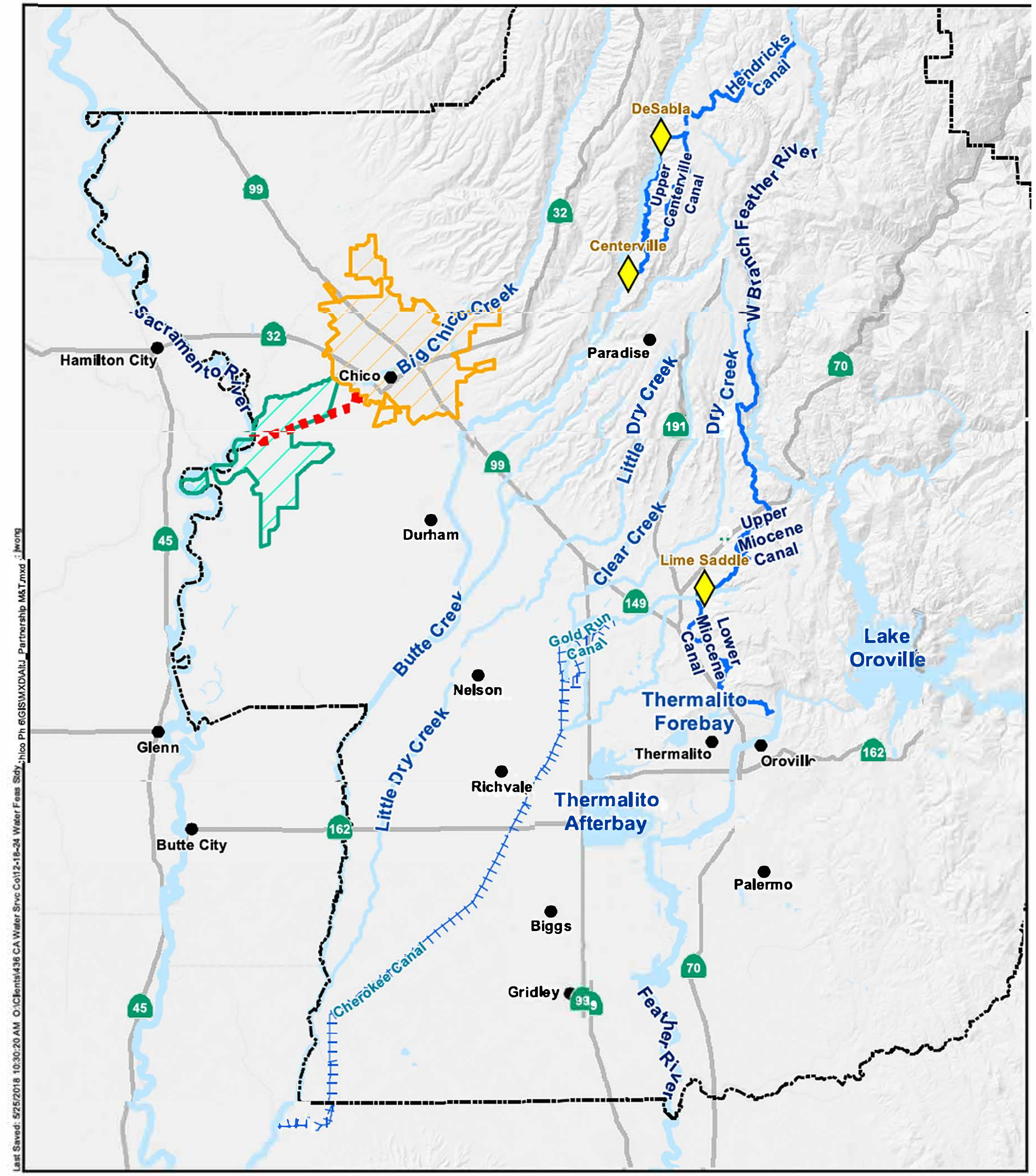


Alternative I

Pipeline and Canal Conveyance from Thermalito Afterbay to Chico District

California Water Service
Surface Water Supply Feasibility Study
Phase 6

Alternative J. Partnership with M&T Ranch to Use Existing Sacramento River Diversion Facilities	
Criteria	Description
Concept Description	• Use available pumping capacity at existing M&T Ranch diversion structure. 40 cfs was estimated to be available in Phase 1. Would require new booster pumping capacity at existing diversion and 5 miles of transmission pipeline to Chico District.
Cost	• $20M (2012 dollars)
Key Issues	• Although diversions from the Sacramento River are possible under the CVP/SWP Coordinated Agreement, Reclamation will not allow diversions that would reduce the cold-water pool at Lake Shasta that is used to meet temperature requirements in the Sacramento River. Affected years would be years following multiple dry years. Temperature modeling would be required to estimate the impact of this issue. • Concerns were identified in Phase 1 of project regarding encroaching gravel bar near M&T diversion, which requires significant maintenance costs.
Questions	• M&T Ranch still a willing partner? • Possible to develop this alternative with groundwater recharge option rather than treatment? • Other potential partners?
Information Needed to Develop/Assess Concept	• Discussion with M&T Ranch • Analysis of options without WTP
Information sources: West Yost Associates, 2012, Summary of Surface Water Delivery Estimate and Evaluation of Preliminary Surface Water Conveyance Projects	



Symbology

Powerhouse

Pipeline from Existing Sacramento River Diversion

Cal Water Chico District

M&T Chico Ranch Service Area

Butte County

0 2.75 5.5

Miles

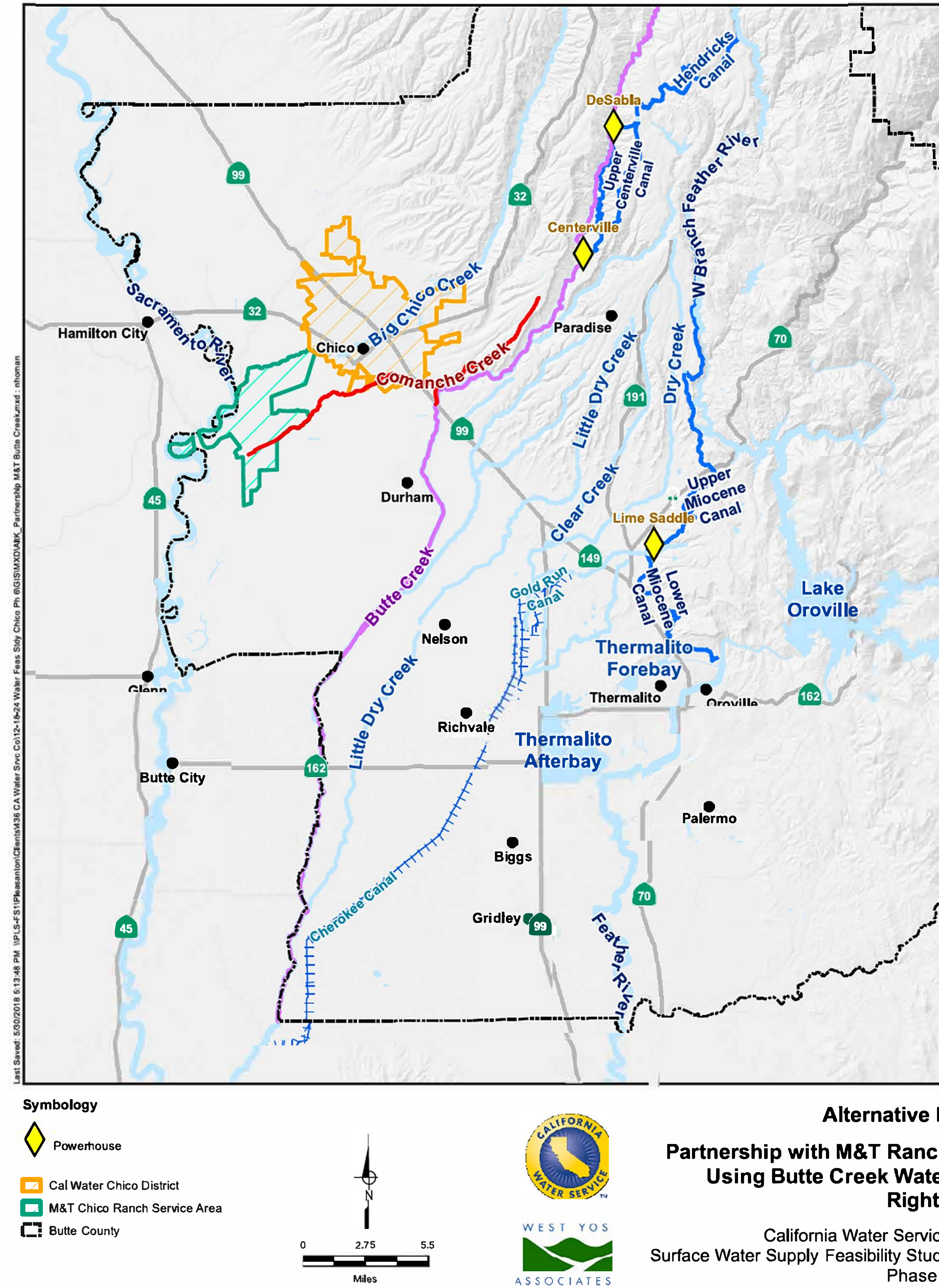
Alternative J

Partnership with M&T Ranch Using Existing Sacramento River Diversion Facilities

California Water Service
Surface Water Supply Feasibility Study
Phase 6

Alternative K. Partnership with M&T Ranch to Use Butte Creek Water Rights

Criteria	Description
Concept Description	• Partner with M&T Ranch to use excess water from its Butte Creek water right that is diverted to Comanche Creek
Cost	• Not yet developed
Key Issues	• Through its existing water right, water is diverted to Comanche Creek from Butte Creek. Comanche Creek does not have the environmental constraints that Butte Creek does.
Questions	• How much water is available? • M&T Ranch still a willing partner? • Locations for recharge that could be used? • Other potential partners?
Information Needed to Develop/Assess Concept	• Discussion with M&T Ranch to better understand quantities of water available and timing, interest, etc.
Information sources:	



Alternative K

Partnership with M&T Ranch Using Butte Creek Water Rights

California Water Service
Surface Water Supply Feasibility Study
Phase 6